UPPER KOBUK DRAINAGE MOOSE CENSUS

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INTRODUCTION

Alaska Department of Fish & Game (ADF&G) and National Park Service (NPS) Gates of the Arctic National Park staff cooperatively estimated moose abundance and composition in the upper Kobuk River drainage during November 1995. We intended to conduct this census in November 1994, but poor snow conditions and weather prevented us from doing so.

There were several reasons for conducting this census. There was no quantitative information for moose in this area, and numbers of guides, transporters and nonlocal hunters appear to have substantially increased in this area since 1990-92. Our objective was to collect baseline information on this moose population before any management problems develop. In addition, members of the Western Interior Subsistence Resource Commission requested survey information for moose and Dall sheep within the park and preserve. The upper Kobuk census area is 1 of 5 areas in Game Management Unit 23 to be regularly censused on a 5-yr rotating basis. Other areas are: middle Noatak drainage; Squirrel drainage; Tagagawik drainage; and northern Seward Peninsula.

Many spring and fall aerial moose surveys have been conducted by ADF&G throughout the Kobuk River drainage since the late 1950s. Unfortunately, early survey techniques, search intensities and count areas varied within and among years. Parameters used to monitor the status of moose were percent calves, twinning rates and moose observed per hour flown. Records and map locations are not available for most moose surveys conducted before 1985.

METHODS

The census area included the Kobuk River from the Mauneluk River drainage to Nutuvukti Lake; northern tributaries of the Kobuk River to their headwaters; and southern tributaries of the Kobuk River north of the crest of the Lockwood Hills (Fig. 1). Principal landowners in this area are the State of Alaska and NPS. Vegetation communities in this area are: upland shrub; upland spruce/birch/shrub; riparian spruce/willow/cottonwood; tussock tundra; and wet sedge meadow.

The census area was initially delineated on U.S.G.S. 1:63,360 scale maps excluding alpine areas higher than 1500 ft and large lakes. The outer boundary was flown in a fixed-wing aircraft and adjusted to include all potential moose habitat while excluding unsuitable areas. The census area was divided into 117 sample units (SU's) and digitized to determine their size. Sample units ranged from 9.0 mi^2 to 15.6 mi^2 (mean 12.4 mi^2; SD 1.6). The census area totaled 1437.7 mi^2.

We based operations at Chris Lie's Dahl Creek camp. This location provided: a large airstrip adequate for fuel delivery by a Douglas DC-4 aircraft; adequate facilities for all personnel; electricity to heat aircraft; bulk fuel tanks for avgas; a telephone; and close proximity to the census area. The Alaska State Troopers allowed 2 persons to use their Dahl Creek cabin. The Bureau of Land Management gave us permission to use their facilities at Dahl Creek (uninsulated buildings), but this was not necessary.

We used a C-185 and 4 Cubs (Piper PA-18 or PA-12) to survey SU's. The C-185 and 2 of the Cubs were owned or leased by ADF&G. Two Cubs were chartered by NPS. Three observers were in the C-185, and each Cub carried 1 observer. Survey techniques for the C-185 and Cubs were identical to those used for Gasaway moose censuses (Gasaway et al. 1986). All pilots and observers were experienced with Gasaway census techniques.

We used linear regression to estimate moose population size and composition (VerHoef, pers. comm.). This technique is being developed to better accomodate weather delays than the Gasaway stratified sampling design. Based on previous experience with Gasaway censuses in Unit 23, we felt the probability of successfully completing this census was highest using linear regression.

Linear regression is similar to the Gasaway technique in that it employs a hierarchical sampling design. A fast, 4-place airplane (a C-185 in this census) surveys all SU's at a low search intensity (roughly 0.5 min/mi^2). A sample of SU's are then surveyed by Cubs at approximately 6 min/mi^2. Finally, 2-3 mi^2 of each SU are surveyed by Cub at approximately 12 min/mi^2 to estimate a sightability correction factor. Aircraft fly the same search patterns for linear regression as for the Gasaway technique.

Linear regression differs from the Gasaway technique in that it subdivides the total census area into subareas and treats each subarea as a separate census. One subarea is surveyed by the C-185 each day. After the C-185 finishes a subarea, all Cubs are sent into that area the following day to complete SU's. To maximize precision, the C-185 should not get >1 day ahead of the Cubs, and the Cubs should complete all selected SU's in a subarea each day. Once all subareas have been completed, the individual estimates are mathematically combined into overall estimates of population size and composition.

The upper Kobuk census area was divided into 3 subareas; southwestern subarea (42 SU's, 503.0 mi^2); southeastern subarea (32 SU's, 419.5 mi^2); and northern subarea (41 SU's, 515.2 mi^2). The subareas were delineated to keep entire drainages within respective portions of the census area as much as possible. That way, if weather temporarily delayed the census and moose moved, they would tend to stay within subareas.

Using linear regression, the number of SU's to be surveyed each day by the Cubs must be determined before the SU's are selected. Once SU's have been selected, none can be added or deleted. Sample units were selected using an algorythmn that made the probability of selection proporitonal to the number of moose observed from the C-185 (i.e., SU's with many moose had a higher probability of being selected than SU's with few moose). Considering daylength, ferry times and fatigue, we decided each of the 4 Cubs would survey 3 SU's daily.

Moose group sizes and locations during the C-185 surveys were recorded on U.S.G.S. 1:250,000 maps. Cub surveys composition data were recorded on standard moose survey observation forms (Gasaway et al. 1986) and locations of moose were plotted on U.S.G.S. 1:63,360 maps.

The census was conducted November 5-9 (Table 1). Weather was clear, cold and calm throughout the census. Snow cover was adequate but less than ideal.

Tens of thousands of caribou were moving through the census area making tracks useless for finding moose.

RESULTS

Sample unit surveys. The C-185 crew observed 60% of the moose seen during the standard intensity Cub surveys.

Cubs generally surveyed 3 SU's daily (range 2-4 SU's) for a total of 37 SU's. Mean search intensity for the standard surveys was 5 minutes/mi^2 (SD 1, n=36). Sightability correction factors (SCF) were estimated for 36 of the 37 SU's surveyed. Sightability was highest in the SE subarea (SCF 1.06) where moose density was highest (0.85 moose/mi^2), and lowest in the N subarea (SCF 1.25) where moose density was lowest (0.19 moose/mi^2).

Population size. The estimate was 815 moose (SD 62) yielding a density of 0.57 moose/mi^2 (Table 2). The 80%, 90%, and 95% confidence intervals were 19%, 24%, and 29% of the total estimate (Table 3). The lower and upper bounds on the population estimate at the 80% confidence level were 663 and 967 moose, respectively.

Population composition. Estimates of bulls, cows and calves were 280, 450 and 85, respectively (Table 1). The estimated bull:cow ratio was 62:100, and the estimated calf:cow ratio was 19:100 (Table 2).

Distribution. Moose density was 0.68 moose/mi^2 in the SW subarea, 0.85 moose/mi^2 in the SE subarea, and 0.19 moose/mi^2 in the N subarea. The north side of the Lockwood Hills (SW and SE subareas, Fig. 1) contained the most moose. Snow was 3 to 8 inches deep in most areas so hadn't forced moose to aggregate in large riparian spruce/willow/cottonwood habitat. Instead, small groups of moose were scattered in upland shrub/spruce habitat and along the upper reaches of small creeks.

COST

The census cost $30,575.00 (ADF&G $13,844; NPS $16,731; Table 10). One hundred twenty seven personnel days were expended in this census, including days spent during 1994 (99.0 ADF&G; 20.0 NPS; 8.5 charter operators). Low intensity surveys required 21.0 hrs of C-185 flight time, and SU surveys required 69.4 hrs of Cub time.

Three thousand gallons of 100LL avgas were delivered to Dahl Creek by Brooks Aviation in September, 1994. Approximately 750 gals of this fuel was stolen from the bulk fuel tanks at Dahl Creek. Survey aircraft used about 1250 gals of avgas.

Chris Lie charged $3000.00 for use of his camp. Slightly over 1000 gals of 100LL avgas were left in Lie's fuel tanks at the end of the census. To everyone's advantage, this unused fuel was used to pay camp rental in full.

DISCUSSION

Estimation technique. The principal advantage of linear regression over the Gasaway technique is that it is less dependent on long periods of good weather. It achieves this 2 ways. First, all Cubs can begin surveying SU's 1 day after the C-185 begins low-intensity surveys. In contrast, the Gasaway technique requires 2-4 days to completely stratify a 1500-2000 mi^2 area during which most or all Cubs cannot begin.

Second, linear regression provides more options if bad weather temporarily delays a census than the Gasaway technique. One option is to wait for good weather and resume the census. Because the C-185 is always just 1 day ahead of the Cubs, only 1 day of C-185 time is lost by continuing a linear regression census after a delay (i.e., 1 subarea must be resurveyed by the C-185 following a weather delay). With linear regression, low-intensity surveys are always "fresh" relative to Cub surveys. In contrast, with the Gasaway technique, the entire census area is stratified at the beginning of the census and its accuracy progressively deteriorates with time. If moose move among linear regression subareas during a weather delay, or if aircraft/personnel cannot wait for good weather, another option is to discontinue the census and accept relatively precise estimates for those subareas already finished. If a Gasaway census is not completed, you must settle for an imprecise estimate for the entire area.

A disadvantage of the regression technique is that SU selections are more rigid than for the Gasaway technique. You must decide *a priori* how many SU's will be surveyed by Super Cubs in each portion of the census area. After SU's have been selected, you cannot add SU's to further reduce the variance of the estimate. Using the Gasaway technique, variance can sometimes be reduced by continuing to count SU's. Stratification deteriorates with time, however, so adding SU's to a Gasaway census does not necessarily reduce variance.

Another disadvantage of the regression technique is that the C-185 must try to see the same proportion of moose in all SU's regardless of density. Sample units that are clearly in high or low strata can be quickly categorized using the Gasaway stratified technique, but not with linear regression.

Several characteristics of this census area reduced the precision of our estimates. Moose density was low; large expanses of dense spruce forest reduced sightability for both the C-185 and Cubs; and moose habitat in the N subarea included steep terrain. Moose sightability was further compromised by insufficient snow to aggregate moose in riparian corridors, and by large numbers of caribou in the area.

Precision would have been higher with a higher search intensity for the C-185. The C-185 missed $\leq$5 moose in 26 of the 37 SU's surveyed. In 5 SU's however, the C-185 missed 12, 14, 15, 22 and 25 moose. Given the low proportion of moose observed by the C-185 in these SU's (33%, 26%, 38%, 19% and 0%, respectively), it is likely they would have been mis-stratified by the Gasaway technique as well. The Gasaway technique would have allowed us to continue sampling SU's to try to reduce the variance. However, this type of error was probably consistent throughout the census area, so adding SU's would not have reduced the variance. These errors were not attributable to an inexperienced pilot or observers, or poor survey conditions. The only way to avoid these types of errors is to increase survey intensity for the C-185.

We could probably have achieved the same level of precision using the Gasaway technique given the excellant weather we experienced. Weather was exceptionally good throughout northwest Alaska during November 1995 and should not be counted on for future censuses.

Management implications. Moose density in the upper Kobuk drainage is low relative to other portions of Unit 23. This is probably attributable to

Table 1. Chronology, aircraft, and flight times for 1993 middle Kobuk drainage moose census.

9/24/94	Dau, Ayres fly census area and adjust boundary (N7063J)
9/28/94	Dau - ferry gear OTZ-Dahl Crk (N7063J)
10/24/94	Dau/Ayres - check snow conditions in census area (N7063J)
2/24/95	Dau - ferry gear Dahl Crk-OTZ (N7063J)
11/4/95	Dau - check snow conditions in census area (N7063J)
11/5/95	Coady, VerHoef & Selinger FAI to Dahl Crk in C-185 (N2635S) Rood, Ayres C-206 load food & gear to Dahl Crk (Rood back to OTZ) Bente OME to OTZ Alaska Airlines Dau & Bente OTZ to Dahl Crk (N7063J)
11/6/95	Coady, VerHoef, Ayres & Bente stratify SW subarea Dau & Selinger set up fuel pump and power for planes Brubaker & Chakuchin FAI to Kobuk/Dahl Crk via Ambler Air Bucknell OTZ to Kobuk/Dahl Crk via Cape Smythe Rood OTZ to Dahl Crk in N8231E (PA-18) Machida OME to Dahl Crk in N2653H (PA-12)
11/7/95	Coady, VerHoef, Ayres & Bente stratify SE subarea Dau/Bucknell, Rood/Brubaker, Machida/Selinger count 3-4 SU's each in SW subarea Lentsch FAI to Dahl Crk (N4123E) Lentsch/Chakuchin count 2 SU's
11/8/95	Coady, VerHoef, Ayres & Bente stratify N subarea Dau/Bucknell, Rood/Brubaker, Machida/Selinger, Lentsch/Chakuchin 3 SU each in SE subarea

Table 1 (cont.).

11/9/95	Coady & Ayres haul 1 load of food & gear Dahl Crk to OTZ
	Coady, VerHoef & Selinger Dahl Crk to FAI
	Dau/Bucknell, Rood/Brubaker, Machida/Selinger, Lentsch/Chakuchin 3 SU each in N subarea
	Lentsch/Brubaker Dahl Crk to FAI
	Rood Dahl Crk to OTZ (N8321E)
11/10/95	Dau, Bucknell, Chakuchin, Bente & Machida clean Dahl Crk
	Bente Dahl Crk to OTZ via Haglund Air, OTZ to OME via Alaska Airlines
	Machida Dahl Crk to OME (N2635S)
	Chakuchin Dahl Crk/Kobuk to FAI via Warbelow Air
	Dau/Bucknell Dahl Crk to OTZ (N7063J)

Table 2. Daily and overall moose population estimates (variance in parentheses) for the 1995 upper Kobuk moose census.

	SW Portion (Day 1)	SE Portion (Day 2)	N Portion (Day 3)	Overall Census Area
Bulls	86 (291.41)	137 (2,271.56)	56 (210.87)	280 (2,773.84)
Cows	215 (3,182.64)	197 (2,254.06)	39 (117.76)	450 (5,554.43)
Calves	49 (200.79)	34 (57.22)	2 (0.64)	85 (258.65)
Total moose	351 (3,861.64)	368 (9,657.41)	96 (643.52)	815 (14,162.57)

Table 3. Eighty, 90 and 95% confidence intervals (percentage of overall estimate in parentheses) for total moose, bull:cow ratio and calf:cow ratio for the 1995 upper Kobuk moose census.

	80% c.i.	90% c.i.	95% c.i.
Total Estimate (815 moose)	±152 (19%)	±195 (24%)	±233 (28%)
Bulls:100 Cows (62)	±20 (32%)	±26 (41%)	±31 (49%)
Calves:100 Cows (19)	±6 (32%)	±8 (41%)	±9 (49%)

Table 4. Personnel time and expenses for the 1995 upper Kobuk moose census.

ADF&G

$ 500.00	Survey observer Susan Bucknell
$ 350.00	Camp assistance Terry Adams
$ 330.90	1:63,360 & 1:250,000 USGS maps
$ 45.00	Romex wire and outlet boxes (heat to aircraft)
$ 560.00	1994 food haul FAI-Dahl Creek
$ 1,192.54	1994 food purchase (donated to Dahl Creek caretaker)
$ 1,485.94	1995 food purchase
$ 3,556.00	C-185 (25.5 hrs @ $140.00/hr)
$ 1,280.00	PA-18 (16.0 hrs @ $80.00/hr; 1994)
$ 4,544.00	PA-12 & PA-18 (56.8 hrs @ $80.00/hr; 1995)
$13,844.38	

NPS

$ 9,700.00	3000 gal 100 LL avgas delivered to Dahl Creek ($3000.00 of this used to pay Chris Lie for use of Dahl Creek camp)
$ 6,492.95	Charter Cubs (2)
$ 300.00	Seat fare Brubaker & Chakuchin FAI to Dahl Creek
$ 200.00	Seat fare Chakuchin Dahl Creek to FAI
$ 38.00	100 lbs propane delivered to Dahl Creek
$16,730.95	

Total $30,575

Table 5. Personnel days for the 1994-95 upper Kobuk moose census

Name	Days	Activity
ADF&G		
Dau	1.0	delineate census area
	1.0	pilot: verify census boundary
	1.0	pilot: check snow conditions census area 1994
	2.0	pilot: ferry gear OTZ-Dahl Crk-OTZ 1994
	1.0	pilot: check snow conditions census area 1995
	1.0	camp: set up fuel pump & elec. for aircraft
	4.0	pilot: survey SU's
	2.0	pilot: OTZ-Dahl Crk-OTZ & close camp
	1.0	data management
	10.0	logistics 1994
	10.0	logistics 1995
	5.0	write final report
Ayres	1.0	delineate census area
	4.0	map SU's
	1.0	copy maps
	1.0	verify census boundary
	1.0	check snow conditions 1994
	4.0	observer
	4.0	purchase food/gear/ferry OTZ-Dahl Crk
	1.0	gear/ferry Dahl Crk-OTZ
Ver Hoef	2.0	FAI-Dahl Crk-FAI
	4.0	observer
	1.0	analysis
Machida	2.0	pilot: OME-Dahl Crk-OME
	4.0	pilot: survey SU's
Uhl	4.0	copy maps
Bucknell	2.0	OTZ-Dahl Crk-OTZ & close camp
	4.0	observer
Selinger	2.0	FAI-Dahl Crk-FAI
	1.0	camp: set up fuel pump & elec. for aircraft
	4.0	observer
Bente	2.0	OME-Dahl Crk-OME
	4.0	observer
	1.0	purchase food 1994
Coady	2.0	pilot: FAI-Dahl Crk-FAI & gear Dahl Crk-OTZ
	4.0	pilot: survey SU's

Table 5 (cont).

Name	Days	Activity
NPS		
Brubaker	1.0	FAI-Dahl Crk-FAI
	4.0	observer
	1.0	purchase food 1994
	3.0	logistics 1994
	2.0	logistics 1995
Chakuchin	2.0	FAI-Dahl Crk-FAI
	4.0	observer
DiFolco	2.0	digitize maps
	1.0	purchase food 1994
Charter operators		
Lentsch	4.0	charter pilot PA-18: survey SU's & ferry
Rood	0.5	charter pilot C-206 gear OTZ-Dahl Crk
	4.0	charter pilot PA-18: survey SU's & ferry
Total	127.5	

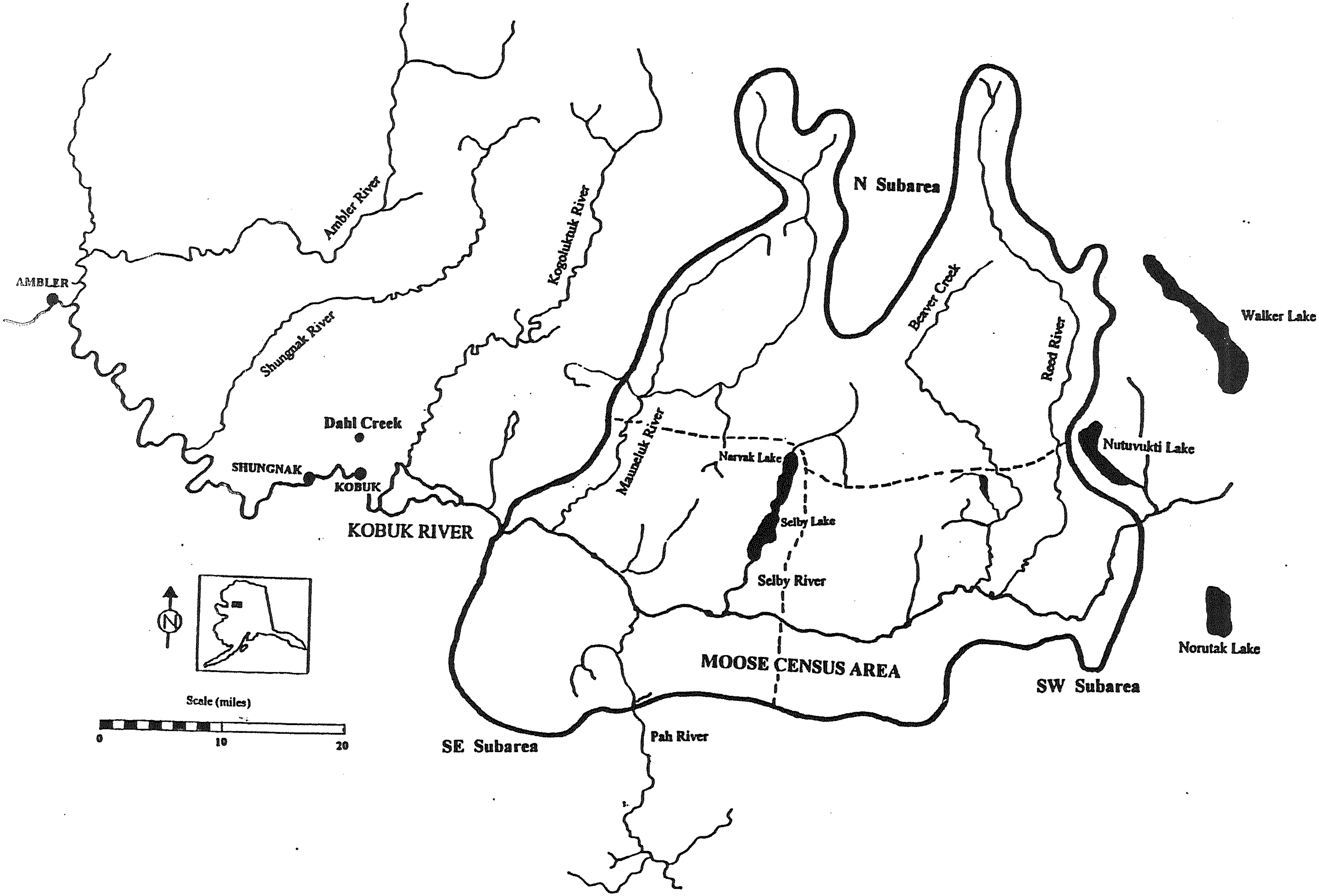
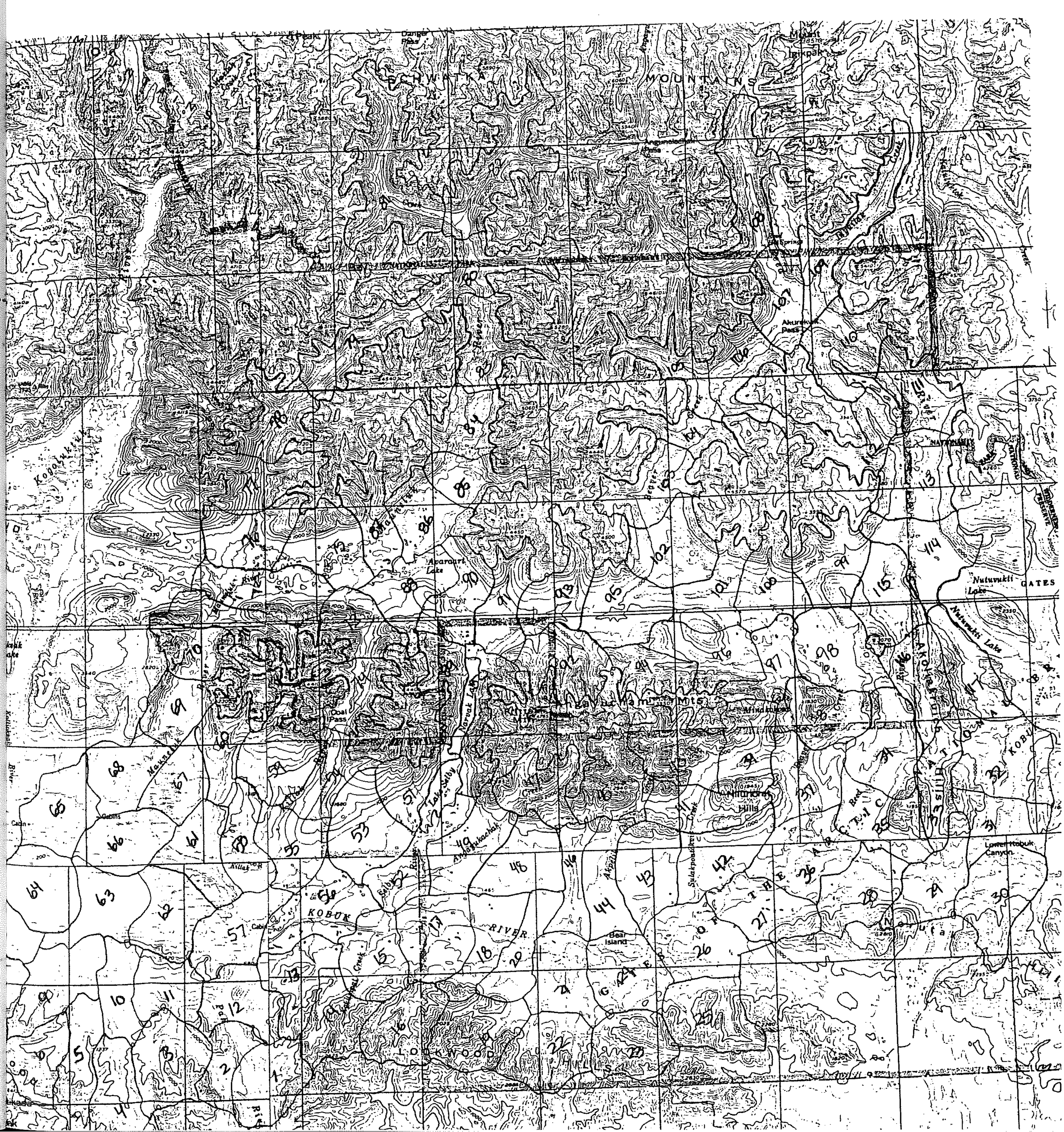


Figure 1. The 1995 upper Kobuk moose census area.


Danger Pass
Mount Igikpak
MOUNTAINS
Akureak Pass
Nutuvukti Lake
GATES
Coal Pass
Lake Selby
Narvak Lake
Nimiuktuk Hills
Cabins
KOBUK
RIVER
Bear Island
Lower Kobuk Canyon
LOCKWOOD

Following is a list of the areas (in square miles) and approximate geographical centers (in degrees and minutes) of subunits (SU) to be surveyed in the Kobuk River Preserve moose survey, October, 1994. Areas and locations were calculated from 1:63,360 scale topographic maps using the "DIGI" program at the Alaska Department of Fish and Game in Fairbanks.

	AREA	------SU CENTER------	
SU	MI^2	LAT.	LONG.
1	14.7	66.40	156.00
2	10.0	66.41	156.05
3	14.2	66.41	156.12
4	11.7	66.39	156.17
5	11.0	66.41	156.21
6	11.1	66.41	156.27
7	11.6	66.43	156.31
8	10.7	66.47	156.30
9	14.5	66.45	156.23
10	9.0	66.44	156.17
11	11.0	66.44	156.12
12	11.2	66.43	156.03
13	12.2	66.44	155.58
14	11.5	66.43	155.52
15	13.4	66.46	155.49
16	13.7	66.42	155.45
17	11.7	66.46	155.42
18	10.9	66.45	155.37
19	13.9	66.42	155.37
20	11.5	66.45	155.33
21	12.7	66.44	155.28
22	15.1	66.41	155.29
23	12.1	66.41	155.20
24	13.5	66.44	155.21
25	14.9	66.42	155.12
26	12.7	66.46	155.13
27	15.1	66.47	155.05
28	13.6	66.47	154.54
29	14.5	66.48	154.46
30	11.7	66.46	154.41
31	13.6	66.50	154.39
32	15.2	66.53	154.39
33	10.6	66.53	154.46
34	14.5	66.53	154.52
35	12.8	66.51	154.54
36	14.6	66.49	155.01
37	13.2	66.52	155.00
38	11.7	66.55	154.59
39	11.9	66.54	155.07
40	14.2	66.54	155.14
41	11.1	66.51	155.12
42	13.2	66.49	155.10
43	13.4	66.49	155.18

SU	AREA MI^2	------SU CENTER------ LAT.	LONG.
44	11.2	66.48	155.23
45	14.3	66.53	155.21
46	10.0	66.48	155.27
47	14.4	66.52	155.30
48	12.7	66.49	155.32
49	11.5	66.50	155.38
50	12.3	66.55	155.35
51	9.2	66.53	155.44
52	12.4	66.49	155.45
53	14.2	66.51	155.49
54	10.4	66.53	155.52
55	11.4	66.50	155.57
56	12.9	66.47	155.55
57	13.9	66.46	156.04
58	10.0	66.51	156.03
59	12.4	66.54	155.59
60	11.4	66.55	156.04
61	11.9	66.50	156.08
62	13.5	66.47	156.11
63	12.8	66.48	156.18
64	14.0	66.49	156.26
65	14.3	66.52	156.24
66	12.6	66.51	156.16
67	9.5	66.53	156.09
68	11.2	66.53	156.16
69	11.8	66.56	156.10
70	11.8	66.59	156.08
71	12.9	67.00	156.02
72	13.8	67.01	155.59
73	12.2	67.00	155.50
74	12.4	66.57	155.50
75	14.0	67.03	155.53
76	12.5	67.04	156.02
77	13.3	67.06	156.01
78	10.7	67.09	155.58
79	10.9	67.12	155.49
80	10.0	67.15	155.36
81	11.6	67.21	155.45
82	12.5	67.20	155.32
83	13.0	67.12	155.35
84	11.0	67.08	155.37
85	10.7	67.06	155.35
86	14.1	67.05	155.41
87	11.8	67.05	155.47
88	12.2	67.01	155.44
89	9.1	66.57	155.39
90	12.4	67.01	155.37
91	13.7	67.01	155.33

SU	AREA MI^2	------SU CENTER------ LAT.	LONG.
92	15.2	66.58	155.27
93	11.0	67.01	155.27
94	9.8	66.57	155.17
95	13.4	67.00	155.20
96	13.8	66.58	155.10
97	10.0	66.58	155.04
98	15.6	66.58	154.57
99	12.1	67.02	154.57
100	12.5	67.01	155.04
101	11.9	67.01	155.10
102	13.7	67.03	155.14
103	13.0	67.06	155.16
104	9.1	67.08	155.13
105	11.3	67.11	155.13
106	12.0	67.11	155.07
107	10.1	67.13	155.03
108	14.0	67.20	155.05
109	10.3	67.14	154.57
110	13.6	67.11	154.54
111	11.6	67.09	154.46
112	9.6	67.07	154.51
113	15.1	67.06	154.47
114	13.9	67.02	154.46
115	12.2	67.00	154.51
116	13.6	66.56	154.48
117	13.4	66.57	154.42

KOBU95D3.SEL

(N = 3 [illegible])

Input file: kobu95d3.dat
Number of samples to be selected: 12
Intercept coefficient: .2000000
Slope coefficient: 2.0000000

						Bulls			Cows				SCF	
SU	Area	X(i)	Y^hat	Pi(i)	S	yr	*md	*lg	w/0	*w/1	*w/2	oth	std	*int
84	11.00	.0	.200	.135	0	*	*		*	*			*	
109	10.30	.0	.200	.135	1	0*	0*	0	0*	0*	0		0*	0
94	9.80	.0	.200	.135	0	*	*		*	*			*	
85	10.70	.0	.200	.135	0	*	*		*	*			*	
106	12.00	.0	.200	.135	0	*	*		*	*			*	
103	13.00	.0	.200	.135	1	0*	0*	0	0*	0*	0		0*	0
104	9.10	.0	.200	.135	0	*	*		*	*			*	
72	13.80	.0	.200	.135	0	*	*		*	*			*	
102	13.70	.0	.200	.135	0	*	*		*	*			*	
86	14.10	.0	.200	.135	1	0*	0*	0	0*	0*	0		0*	0
110	13.60	.0	.200	.135	0	*	*		*	*			*	
108	14.00	.0	.200	.135	0	*	*		*	*			*	
87	11.80	.0	.200	.135	0	*	*		*	*			*	
83	13.00	.0	.200	.135	0	*	*		*	*			*	
112	9.60	.0	.200	.135	0	*	*		*	*			*	
107	10.10	.0	.200	.135	0	*	*		*	*			*	
111	11.60	.0	.200	.135	1	0*	0*	0	0*	0*	0		0*	0
82	12.50	.0	.200	.135	0	*	*		*	*			*	
105	11.30	.0	.200	.135	0	*	*		*	*			*	
113	15.10	.0	.200	.135	0	*	*		*	*			*	
92	15.20	.5	.266	.179	0	*	*		*	*			*	
88	12.20	.5	.282	.190	0	*	*		*	*			*	
97	10.00	.5	.300	.202	0	*	*		*	*			*	
114	13.90	1.0	.344	.231	0	*	*		*	*			*	
91	13.70	1.0	.346	.233	0	*	*		*	*			*	
95	13.40	1.0	.349	.235	0	*	*		*	*			*	
90	12.40	1.0	.361	.243	0	*	*		*	*			*	
101	11.90	1.0	.368	.248	0	*	*		*	*			*	
96	13.80	2.0	.490	.330	1	0*	0*	2	0*	0*	0		2*	3
93	11.00	2.0	.564	.379	0	*	*		*	*			*	
98	15.60	3.0	.585	.393	0	*	*		*	*			*	
75	14.00	3.0	.629	.423	1	0*	0*	0	0*	0*	0		0*	0
99	12.10	3.0	.696	.468	1	0*	0*	0	0*	0*	0		0*	3
81	11.60	3.0	.717	.483	0	*	*		*	*			*	
80	10.00	3.0	.800	.538	1	0*	0*	0	0*	0*	0		0*	0
77	13.30	4.0	.802	.539	0	*	*		*	*			*	
115	12.20	4.0	.856	.576	0	*	*		*	*			*	
78	10.70	4.0	.948	.638	1	0*	0*	2	1*	0*	0		0*	0
76	12.50	6.0	1.160	.781	1	0*	7*	0	4*	1*	0		13*	14
79	10.90	9.0	1.851	1.000	1	0*	6*	5	13*	0*	0		3*	6
100	12.50	14.0	2.440	1.000	1	4*	3*	4	5*	0*	0		0*	0

KOBU75D3.DAT

(N 2 quadrants)

72	13.8	0	
75	14.0	3	0 *
76	12.5	6	13
77	13.3	4	
78	10.7	4	3 *
79	10.9	9	24
80	10.0	3	0 *
81	11.6	3	
82	12.5	0	
83	13.0	0	
84	11.0	0	
85	10.7	0	
86	14.1	0	0
87	11.8	0	
88	12.2	0.5	
90	12.4	1	
91	13.7	1	
92	15.2	0.5	
93	11.0	2	
94	9.8	0	
95	13.4	1	
96	13.8	2	2
97	10.0	0.5	
98	15.6	3	
99	12.1	3	0 *
100	12.5	14	16
101	11.9	1	
102	13.7	0	
103	13.0	0	0
104	9.1	0	
105	11.3	0	
106	12.0	0	
107	10.1	0	
108	14.0	0	
109	10.3	0	0
110	13.6	0	
111	11.6	0	0
112	9.6	0	
113	15.1	0	
114	13.9	1	
115	12.2	4	

KOBU95D2.SEC
(SEquential)

Input file: kobu95d2.dat
Number of samples to be selected: 12
Intercept coefficient: .2000000
Slope coefficient: 2.0000000

						Bulls			Cows				SCF	
SU	Area	X(i)	Y^hat	Pi(i)	S	yr	*md	*lg	w/0	*w/1	*w/2	oth	std	*int
38	11.70	.0	.200	.220	0	*	*		*	*			*	
48	12.70	.0	.200	.220	0	*	*		*	*			*	
44	11.20	.0	.200	.220	0	*	*		*	*			*	
34	14.50	.0	.200	.220	1	4*	3*	3	11*	2*			0*	0
116	13.60	.0	.200	.220	0	*	*		*	*			*	
27	15.10	1.0	.332	.220	1	*	*		*	1*			0*	0
42	13.20	1.0	.352	.220	0	*	*		*	*			*	
39	11.90	1.0	.368	.220	1	*	*		3*	*			3*	4
29	14.50	2.0	.476	.220	0	*	*		*	*			*	
31	13.60	2.0	.494	.220	0	*	*		*	*			*	
43	13.40	2.0	.499	.220	0	*	*		*	*			*	
117	13.40	2.0	.499	.220	0	*	*		*	*			*	
21	12.70	2.0	.515	.220	0	*	*		*	*			*	
46	10.00	2.0	.600	.220	0	*	*		*	*			*	
36	14.60	4.0	.748	.220	0	*	*		*	*			*	
37	13.20	4.0	.806	.220	0	*	*		*	*			*	
35	12.80	4.0	.825	.220	1	*	*		2*	1*			0*	0
26	12.70	4.0	.830	.220	0	*	*		*	*			*	
32	15.20	5.0	.858	.220	0	*	*		*	*			*	
22	15.10	5.0	.862	.220	0	*	*		*	*			*	
30	11.70	4.0	.884	.386	0	*	*		*	*			*	
47	14.40	5.0	.894	.391	1	*	6*	7	12*	1*			12*	12
41	11.10	4.0	.921	.402	0	*	*		*	*			*	
28	13.60	5.0	.935	.409	0	*	*		*	*			*	
24	13.50	6.0	1.089	.476	0	*	*		*	*			*	
25	14.90	7.0	1.140	.498	0	*	*		*	*			*	
19	13.90	7.0	1.207	.528	1	1*	5*		1*	*			0*	0
33	10.60	6.0	1.332	.582	1	1*	5*	3	9*	*			0*	0
40	14.20	9.0	1.468	.641	1	*	2*	1	4*	1*			2*	3
18	10.90	7.0	1.484	.649	1	*	1*		3*	3*			2*	2
45	14.30	11.0	1.738	.760	1	*	2*	4	1*	1*			1*	1
23	12.10	11.0	2.018	.882	1	*	*	1	5*	2*			5*	5
20	11.50	12.0	2.287	.999	1	*	4*	1	6*	*			0*	0

KOBU95D2.DF

(SE question)

18	10.9	7	10
19	13.9	7	7
20	11.5	12	11 *
21	12.7	2	
22	15.1	5	
23	12.1	11	10 *
24	13.5	6	
25	14.9	7	
26	12.7	4	
27	15.1	1	2
28	13.6	5	
29	14.5	2	
30	11.7	4	
31	13.6	2	
32	15.2	5	
33	10.6	6	18
34	14.5	0	25
35	12.8	4	4
36	14.6	4	
37	13.2	4	
38	11.7	0	
39	11.9	1	3
40	14.2	9	9
41	11.1	4	
42	13.2	1	
43	13.4	2	
44	11.2	0	
45	14.3	11	9 *
46	10.0	2	
47	14.4	5	27
48	12.7	0	
116	13.6	0	
117	13.4	2	

KOBU95D1.SEL

(SW [illegible])

Input file: kobu95d1.dat
Number of samples to be selected: 13
Intercept coefficient: .2000000
Slope coefficient: 2.0000000

SU	Area	X(i)	Y^hat	Pi(i)	S	Bulls yr	*md	*lg	Cows w/0	*w/1	*w/2	oth	SCF std	*int
64	14.00	.0	.200	.117	1	*	*		*	*			0*	0
73	12.20	.0	.200	.117	0	*	*		*	*			*	
66	12.60	.0	.200	.117	0	*	*		*	*			*	
49	11.50	.0	.200	.117	0	*	*		*	*			*	
63	12.80	.0	.200	.117	0	*	*		*	*			*	
68	11.20	.0	.200	.117	0	*	*		*	*			*	
89	9.10	.0	.200	.117	0	*	*		*	*			*	
56	12.90	.0	.200	.117	0	*	*		*	*			*	
71	12.90	.0	.200	.117	0	*	*		*	*			*	
52	12.40	.0	.200	.117	0	*	*		*	*			*	
50	12.30	.0	.200	.117	0	*	*		*	*			*	
69	11.80	.0	.200	.117	0	*	*		*	*			*	
61	11.90	.0	.200	.117	0	*	*		*	*			*	
67	9.50	.0	.200	.117	0	*	*		*	*			*	
55	11.40	.0	.200	.117	0	*	*		*	*			*	
53	14.20	.5	.270	.117	0	*	*		*	*			*	
8	10.70	1.0	.387	.117	0	*	*		*	*			*	
54	10.40	1.0	.392	.117	1	*	*		5*	*			0*	0
58	10.00	1.0	.400	.117	0	*	*		*	*			*	
65	14.30	2.0	.480	.117	0	*	*		*	*			*	
62	13.50	2.0	.496	.117	0	*	*		*	*			*	
70	11.80	2.0	.539	.117	0	*	*		*	*			*	
4	11.70	2.0	.542	.233	0	*	*		*	*			*	
17	11.70	2.0	.542	.233	0	*	*		*	*			*	
3	14.20	3.0	.623	.268	0	*	*		*	*			*	
57	13.90	3.0	.632	.272	0	*	*		*	*			*	
51	9.20	2.0	.635	.274	0	*	*		*	*			*	
7	11.60	3.0	.717	.309	1	3*	1*		3*	*			2*	2
60	11.40	3.0	.726	.313	1	*	*	1	*	*			0*	0
2	10.00	3.0	.800	.345	1	*	2*	1	3*	2*			0*	0
14	11.50	4.0	.896	.386	0	*	*		*	*			*	
16	13.70	5.0	.930	.401	0	*	*		*	*			*	
13	12.20	5.0	1.020	.439	1	*	1*		6*	6*			11*	12
10	9.00	4.0	1.089	.469	0	*	*		*	*			*	
12	11.20	5.0	1.093	.471	1	*	*	1	5*	3*			2*	3
59	12.40	6.0	1.168	.503	0	*	*		*	*			*	
6	11.10	6.0	1.281	.552	1	*	3*	1	6*	*			5*	8
15	13.40	8.0	1.394	.601	1	*	3*	3	6*	2*			-1*	
74	12.40	10.0	1.813	.781	1	*	2*	6	3*	2*			0*	0
11	11.00	9.0	1.836	.791	0	*	*		*	*			*	
5	11.00	10.0	2.018	.870	1	1*	6*	1	4*	1*			3*	3
9	14.50	14.0	2.131	.918	1	*	3*		6*	3*	2		2*	2
1	14.70	19.0	2.785	1.000	1	2*	2*	2	3*	4*			1*	1

K03495D1.DAT

(Stratification results for SW quadrant of upper [illegible] [illegible]; [illegible] / Velley [illegible] / [illegible])

SU	Area	# [illegible] observed	[illegible]
1	14.7	19	17 *
2	10.0	3	10
3	14.2	3	
4	11.7	2	
5	11.0	10	14
6	11.1	6	10
7	11.6	3	7
8	10.7	1	
9	14.5	14	21
10	9.0	4	
11	11.0	9	
12	11.2	5	12
13	12.2	5	19
14	11.5	4	
15	13.4	8	16
16	13.7	5	
17	11.7	2	
49	11.5	0	
50	12.3	0	
51	9.2	2	
52	12.4	0	
53	14.2	0.5	
54	10.4	1	5
55	11.4	0	
56	12.9	0	
57	13.9	3	
58	10.0	1	
59	12.4	6	
60	11.4	3	1 +
61	11.9	0	
62	13.5	2	
63	12.8	0	
64	14.0	0	0
65	14.3	2	
66	12.6	0	
67	9.5	0	
68	11.2	0	
69	11.8	0	
70	11.8	2	
71	12.9	0	
73	12.2	0	
74	12.4	10	15
89	9.1	0	

limited high quality habitat, high numbers of predators, and deep snow during most winters.

The high bull:cow ratio suggests hunting has probably had little effect on this moose population. Most of the area is not hunted by local residents because moose are readily available closer to the villages. Until recently, few nonlocal hunters or commercial operators used this area because limited access, distance from support centers e.g. Kotzebue and Bettles, and dense spruce forests make it difficult to harvest moose.

Interest in hunting the upper Kobuk River drainage by nonlocal hunters and commercial operators seems to have substantially increased during the past several years. This trend is partially attributable to deteriorating hunting conditions and opportunities elsewhere in Unit 23 and the state overall. In addition, the size of the Western Arctic Caribou herd and liberal caribou bag limit have attracted many hunters to Unit 23 who often hunt moose and caribou simultaneously.

RECOMMENDATIONS

1. Repeat the upper Kobuk moose census in approximately 5 years (2000) unless there is some indication that the population has substantially declined.

2. Use linear regression to estimate moose population parameters, but increase survey intensity for the C-185. This could be accomplished by: 1) dividing the census area into 4 subareas $\leq$350-375 mi^2 each, and 2) increasing C-185 search intensity from 0.50 min/mi^2 to roughly 0.85 min/mi^2 (i.e., the C-185 would spend roughly 10-11 minutes in each SU). This would allow the C-185 to complete 1 subarea each day, and add 1 day to the overall census.

3. Annually monitor number and location of hunters and commercial operators in the upper Kobuk River drainage.

4. Estimate the number of moose harvested by upper Kobuk River villages using a community-based harvest assessment technique.

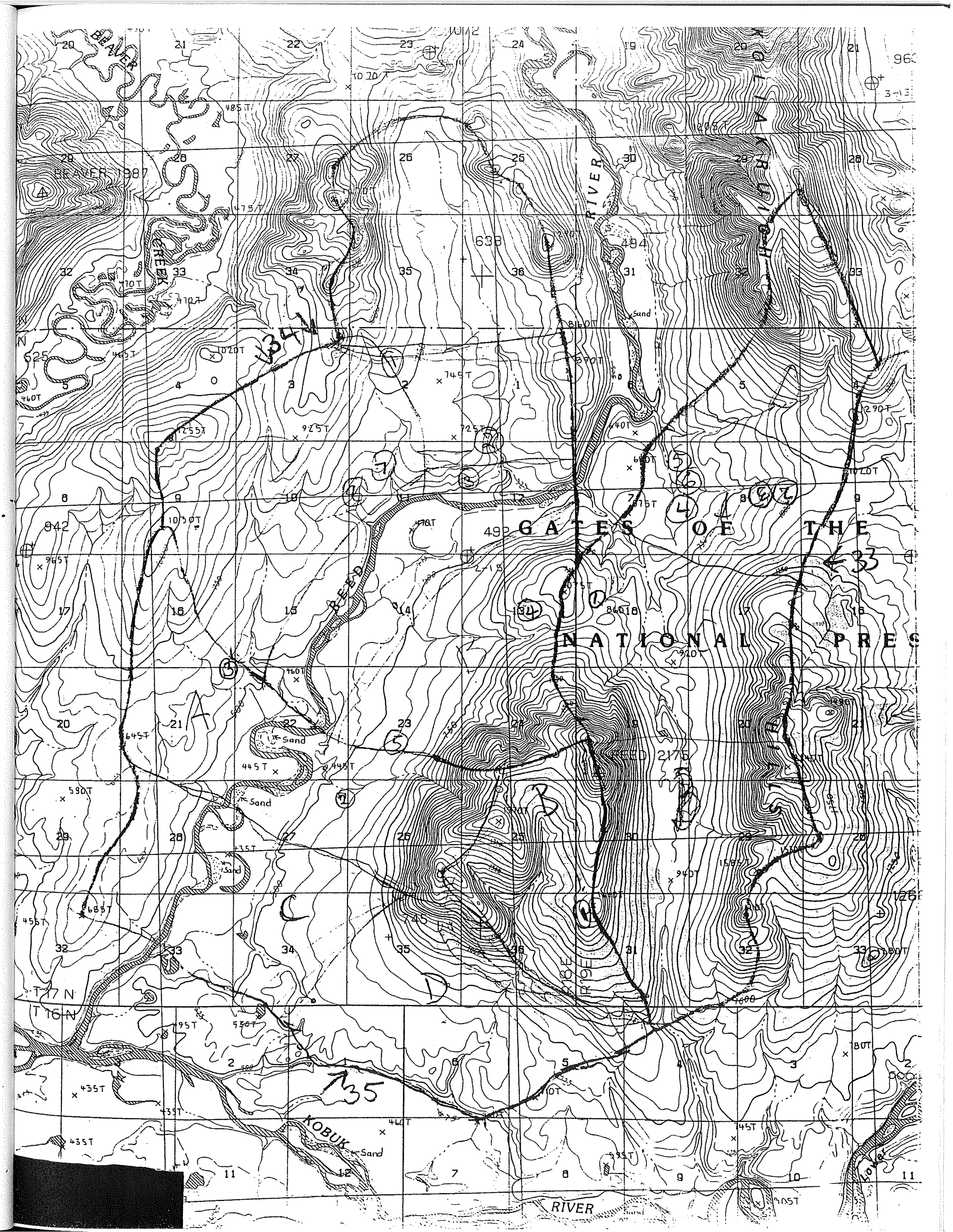
5. Consider the upper Kobuk drainage in an assessment of public opinion regarding moose management goals and objectives throughout Unit 23. This assessment should include: local subsistence users; nonlocal sport hunters;

commercial operators (guides and transporters); and nonconsumptive users (tour group operators and tourists).

6. If Chris Lie's camp is not available as a base for future censuses, alternatives are the NANA Bornite Mine camp or Walker's Lodge in Shungnak.

LITERATURE CITED

Gasaway, W.C., S.D. DuBois, D. Reed and S.J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biol. Paper No. 22, Univ. of Alaska, Fairbanks, AK. 108 pp.


BEAVER
BEAVER 1987
CREEK
RIVER
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REED
REED 2175
KOBUK
RIVER
Sand
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135
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15

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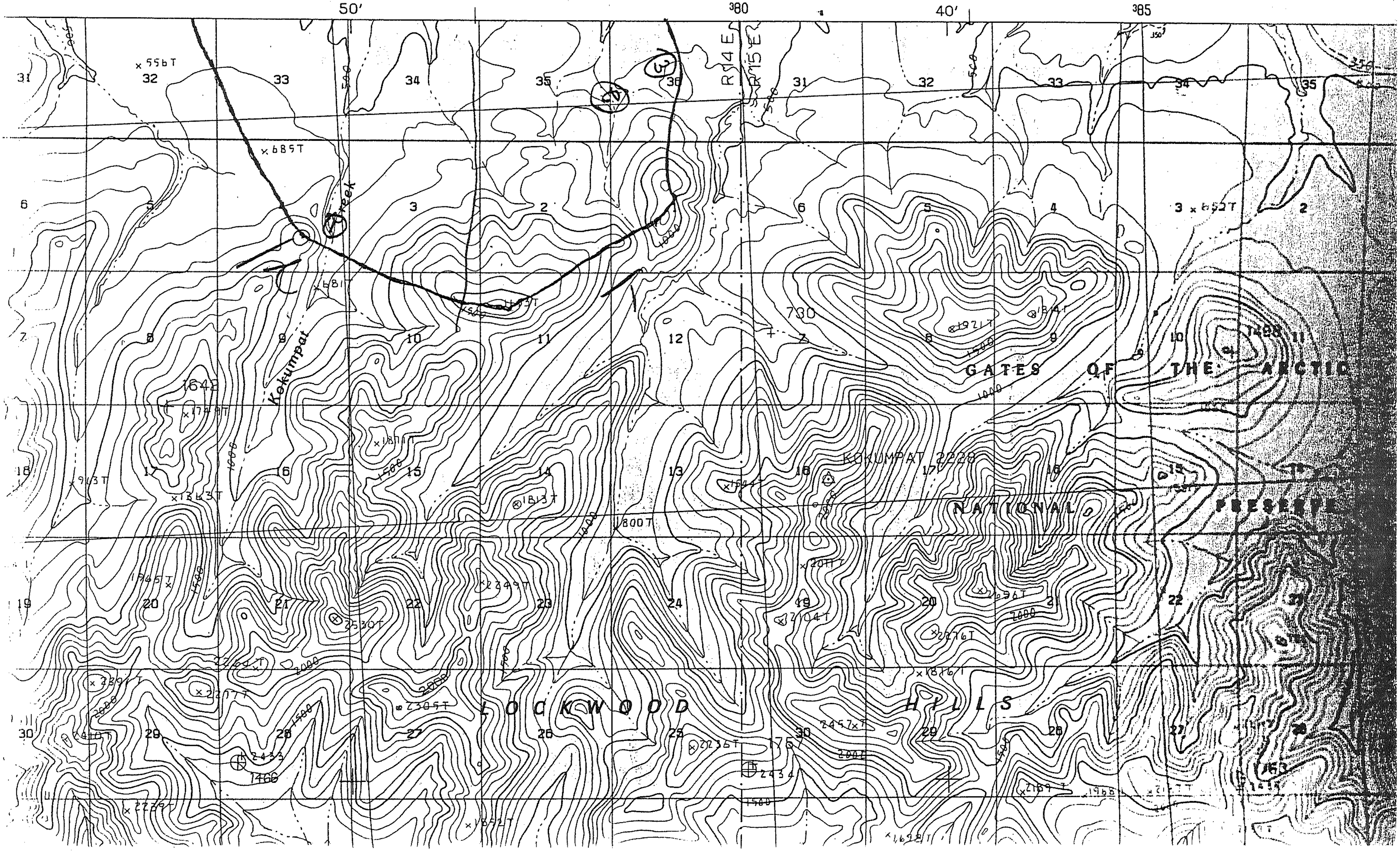
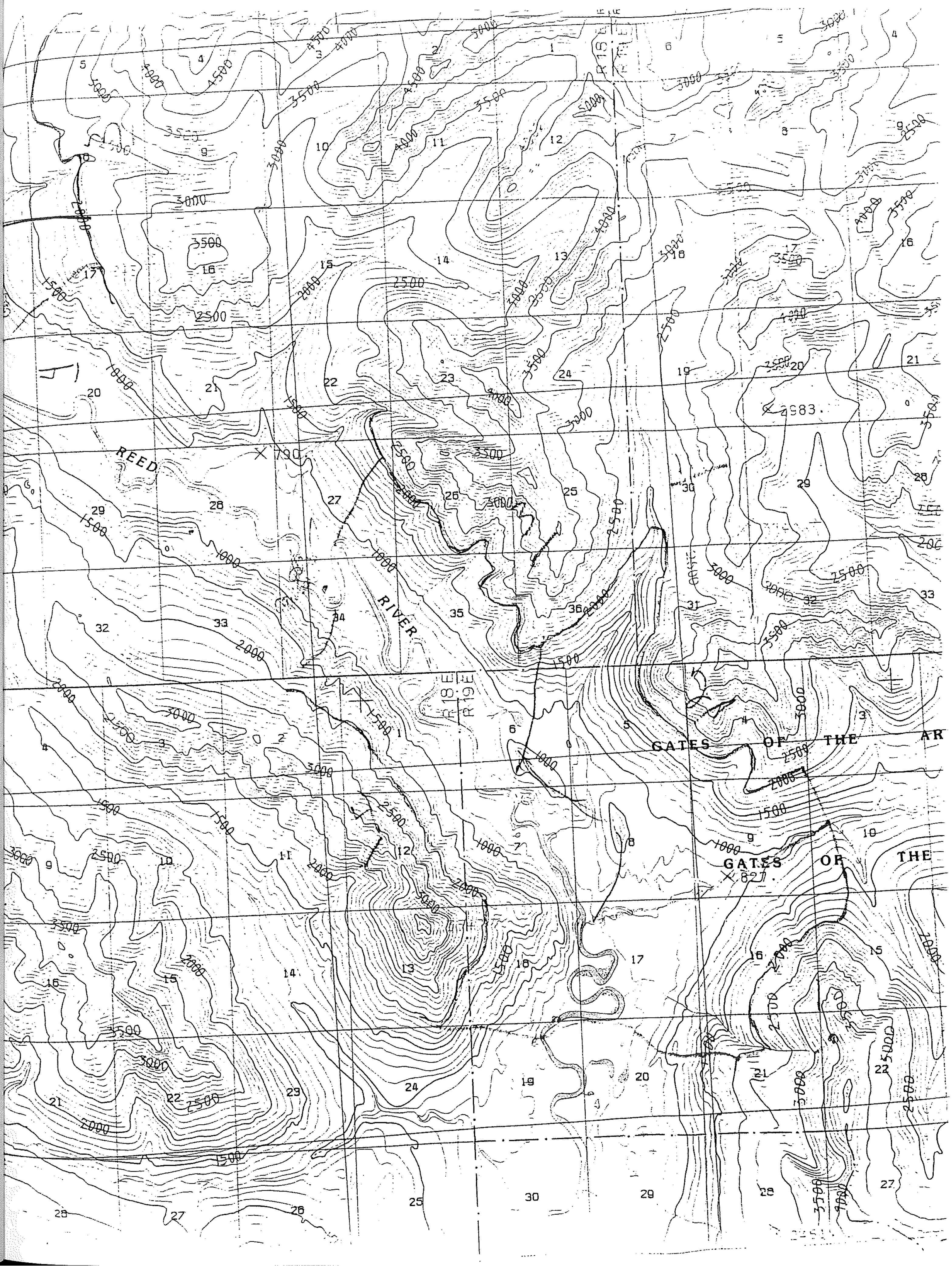
HUGHES (C–6) Q
ALASK
1:63 360 SERIES (T




REED
RIVER
GATES OF THE AR
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R18E
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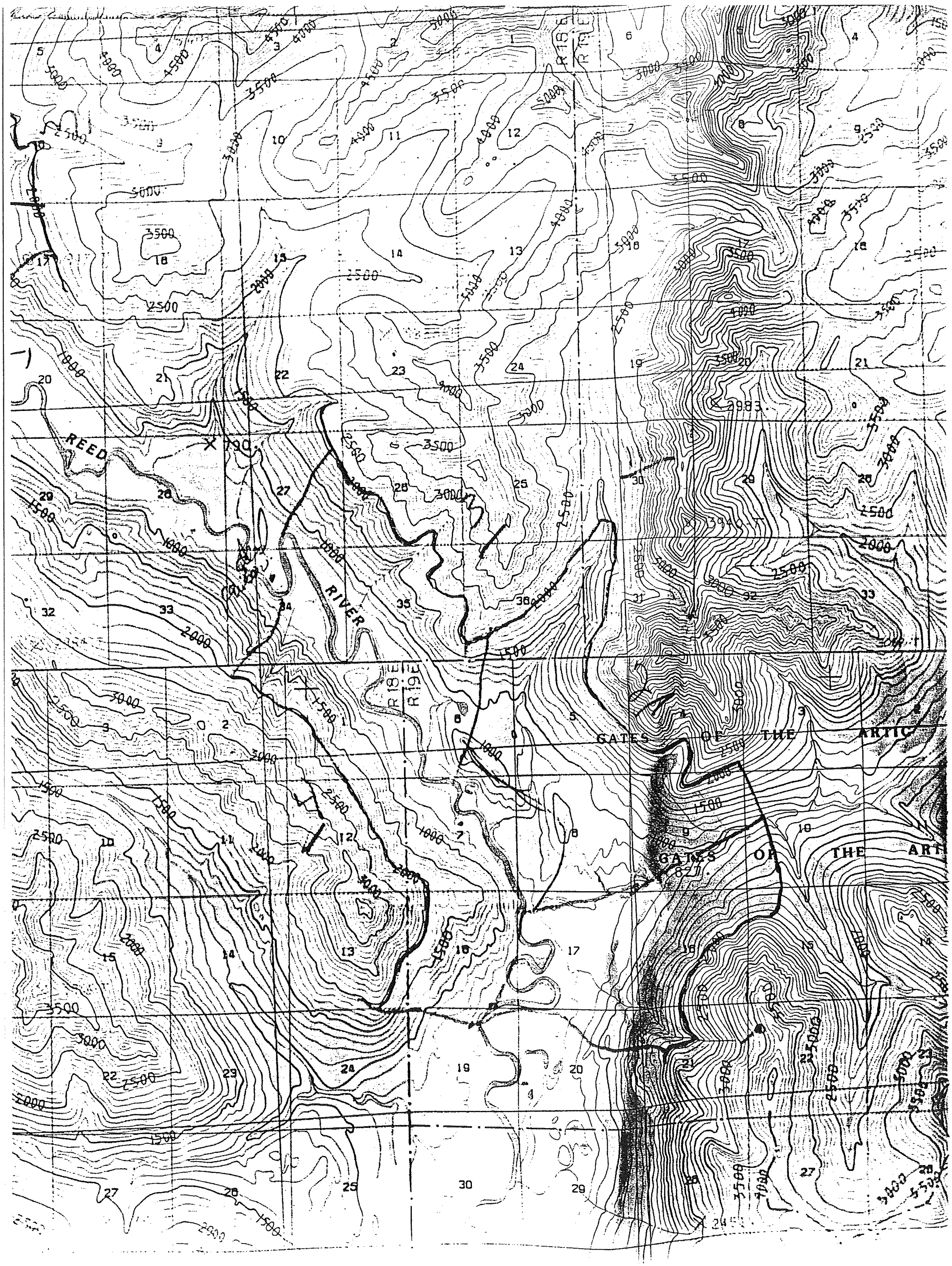
790
827
2983


REED
RIVER
GATES OF THE ARTIC
GATES OF THE ARTI
R18E
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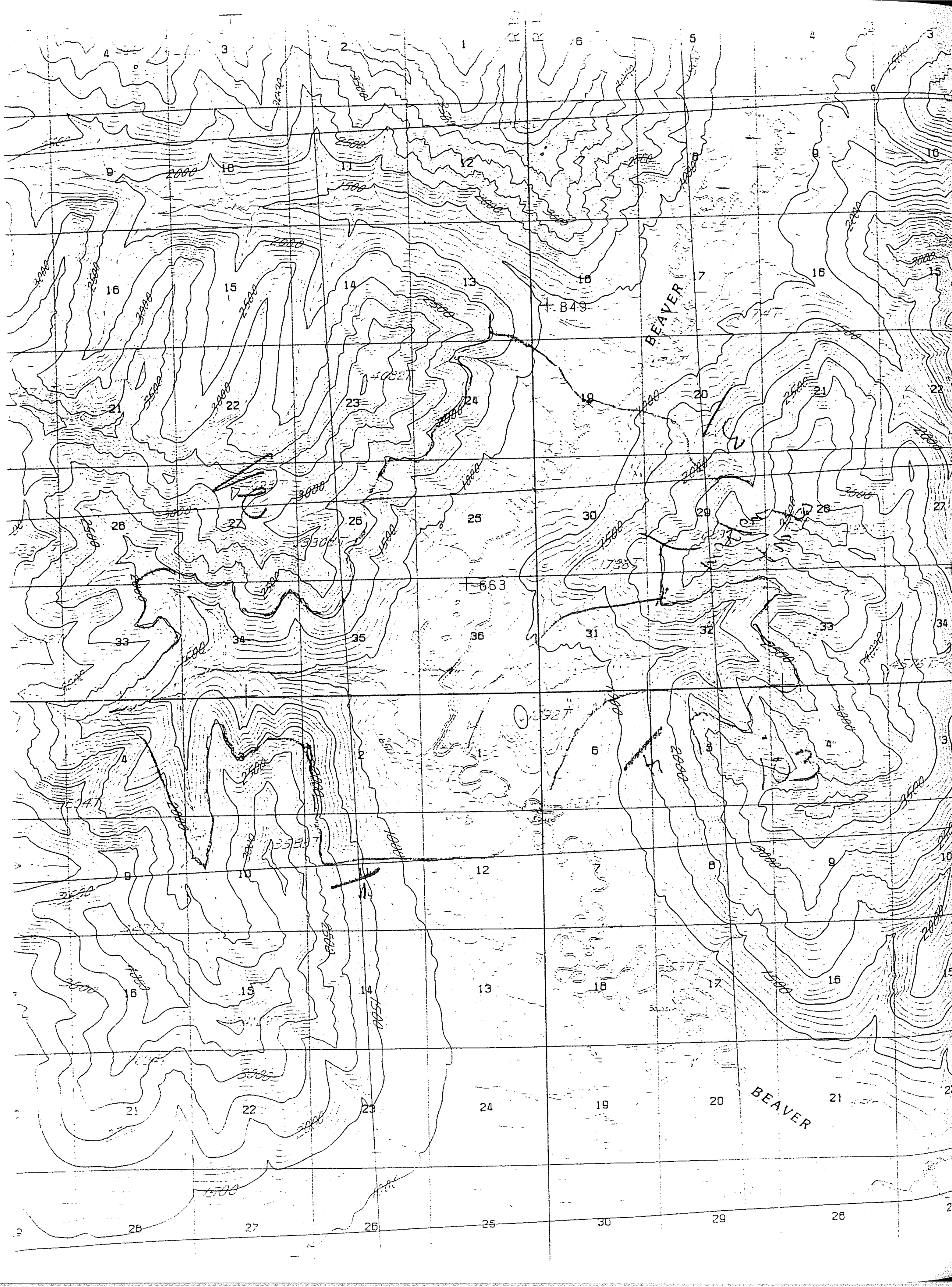
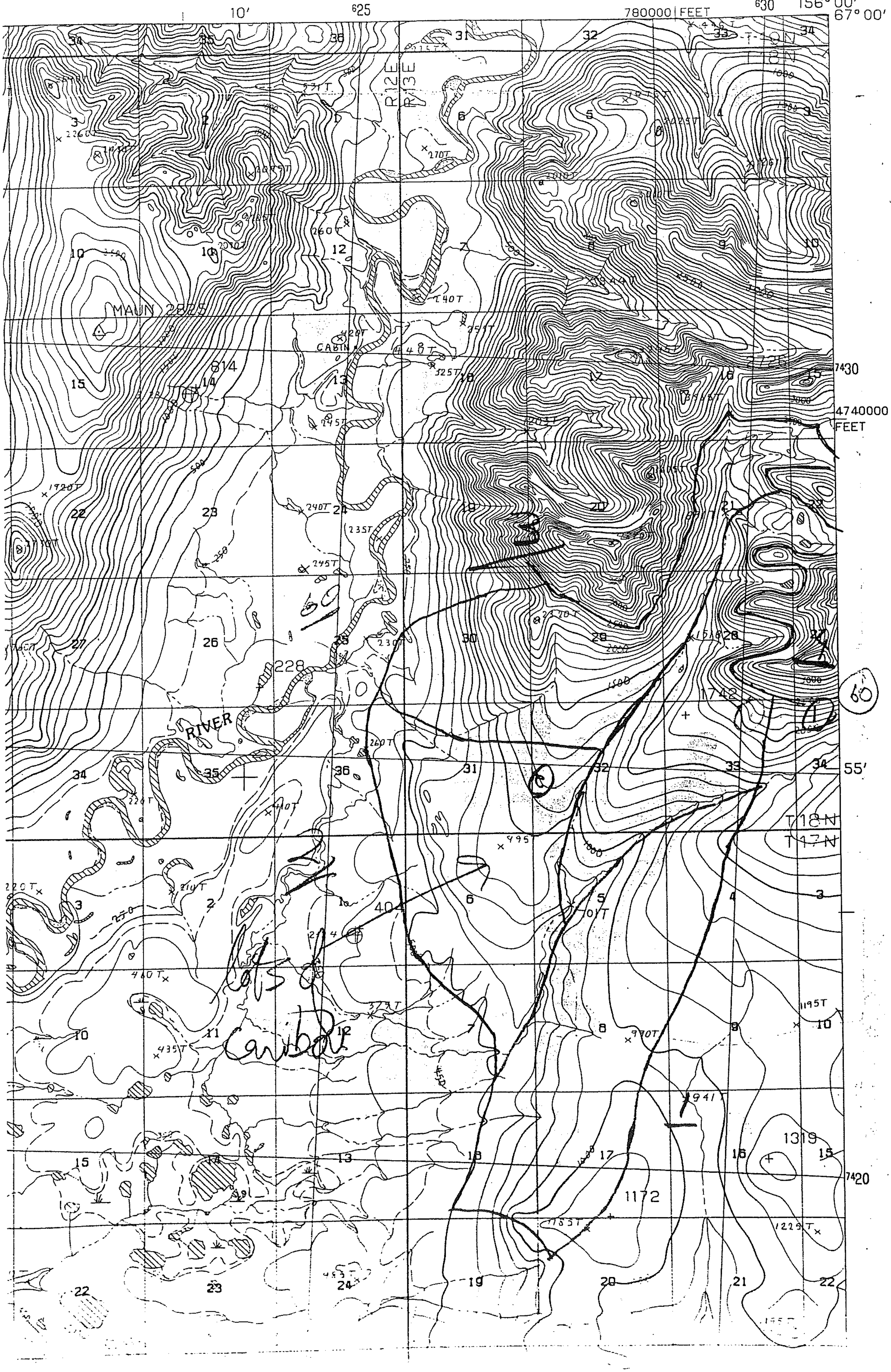
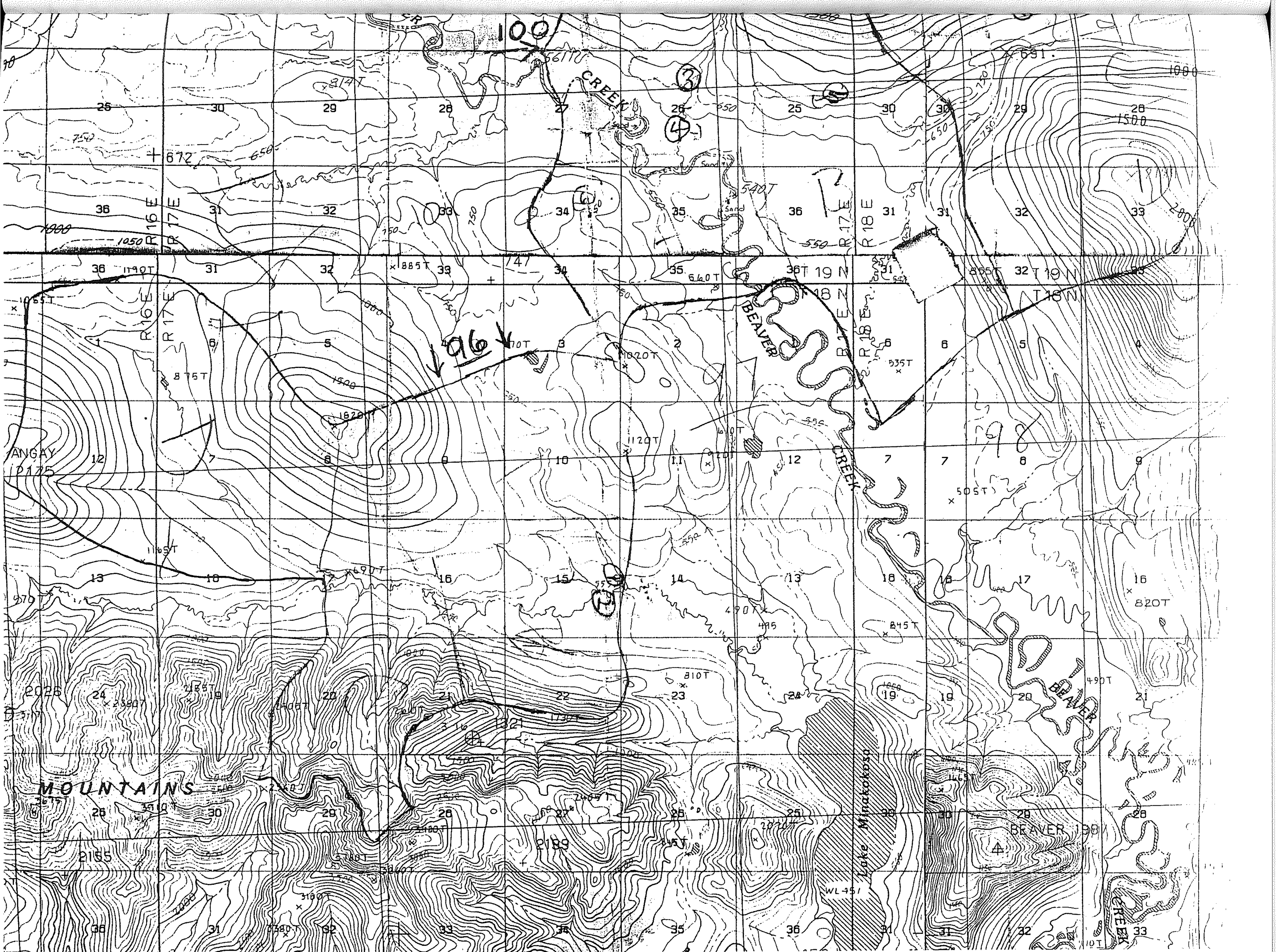
790
2983
3940
3500
3000
2500
2000
1500
1000

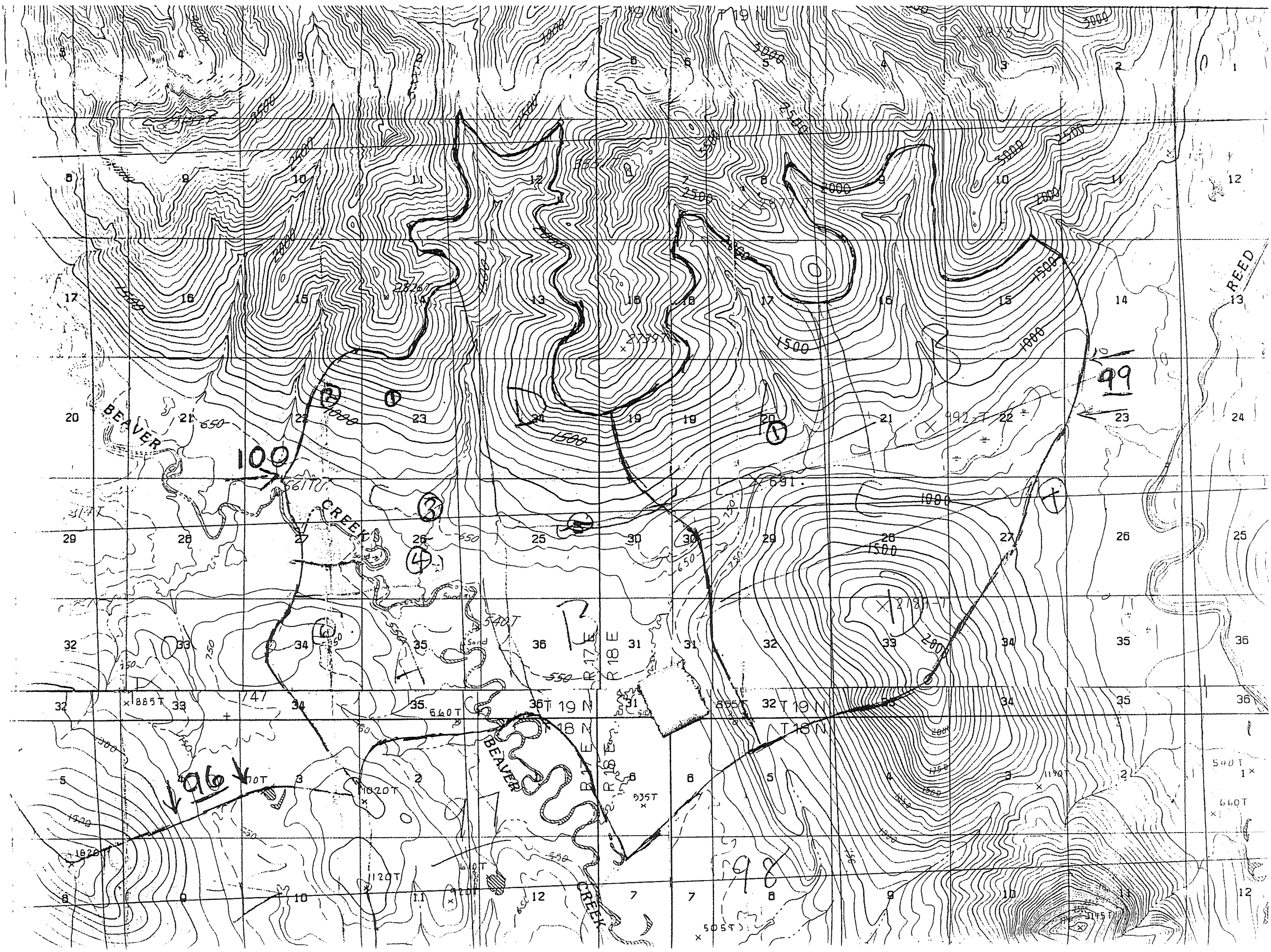

BEAVER
BEAVER
849
663
4327
1738
3302
4082
3597

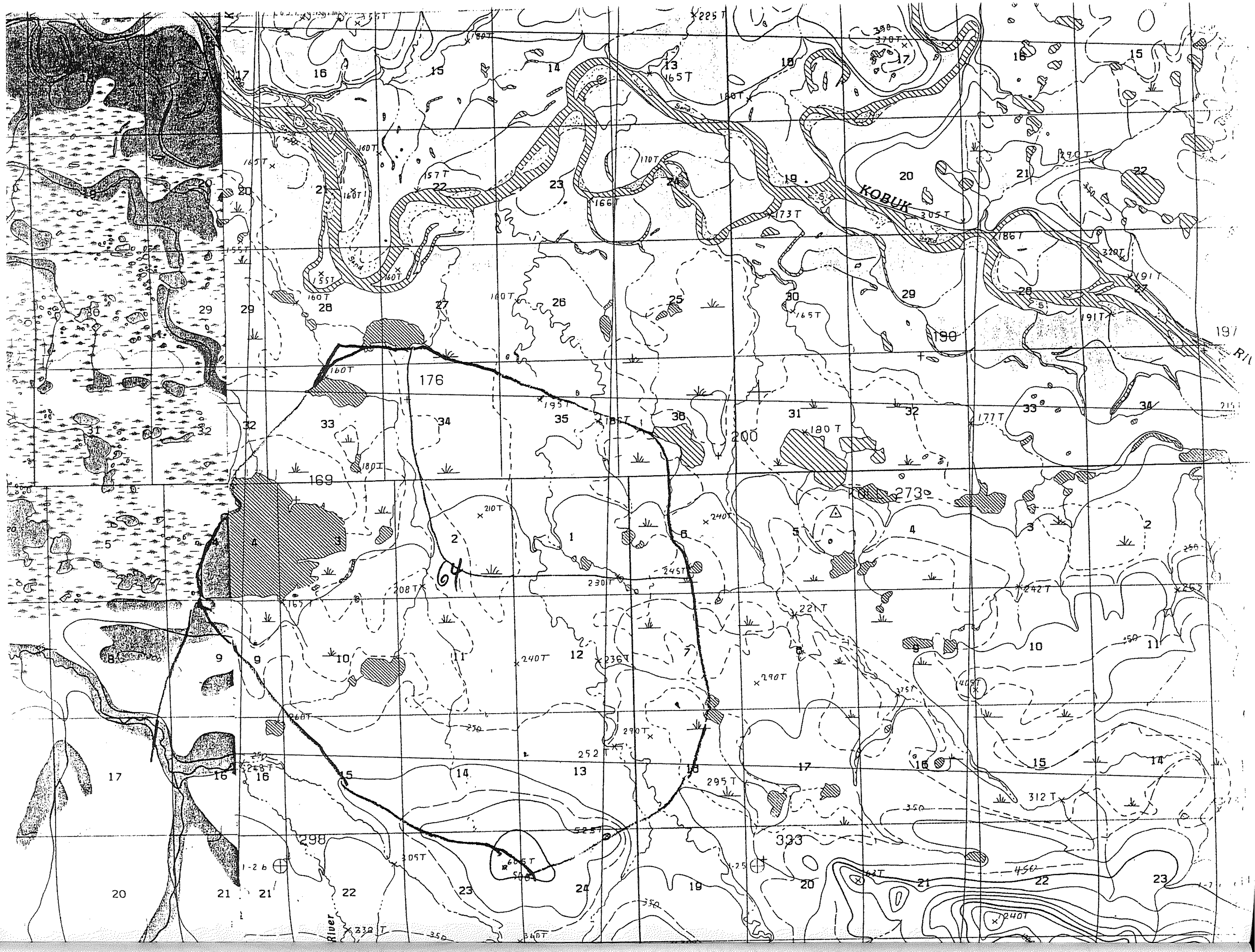
1:63 360 SERIES (TOPOGRAPHIC)





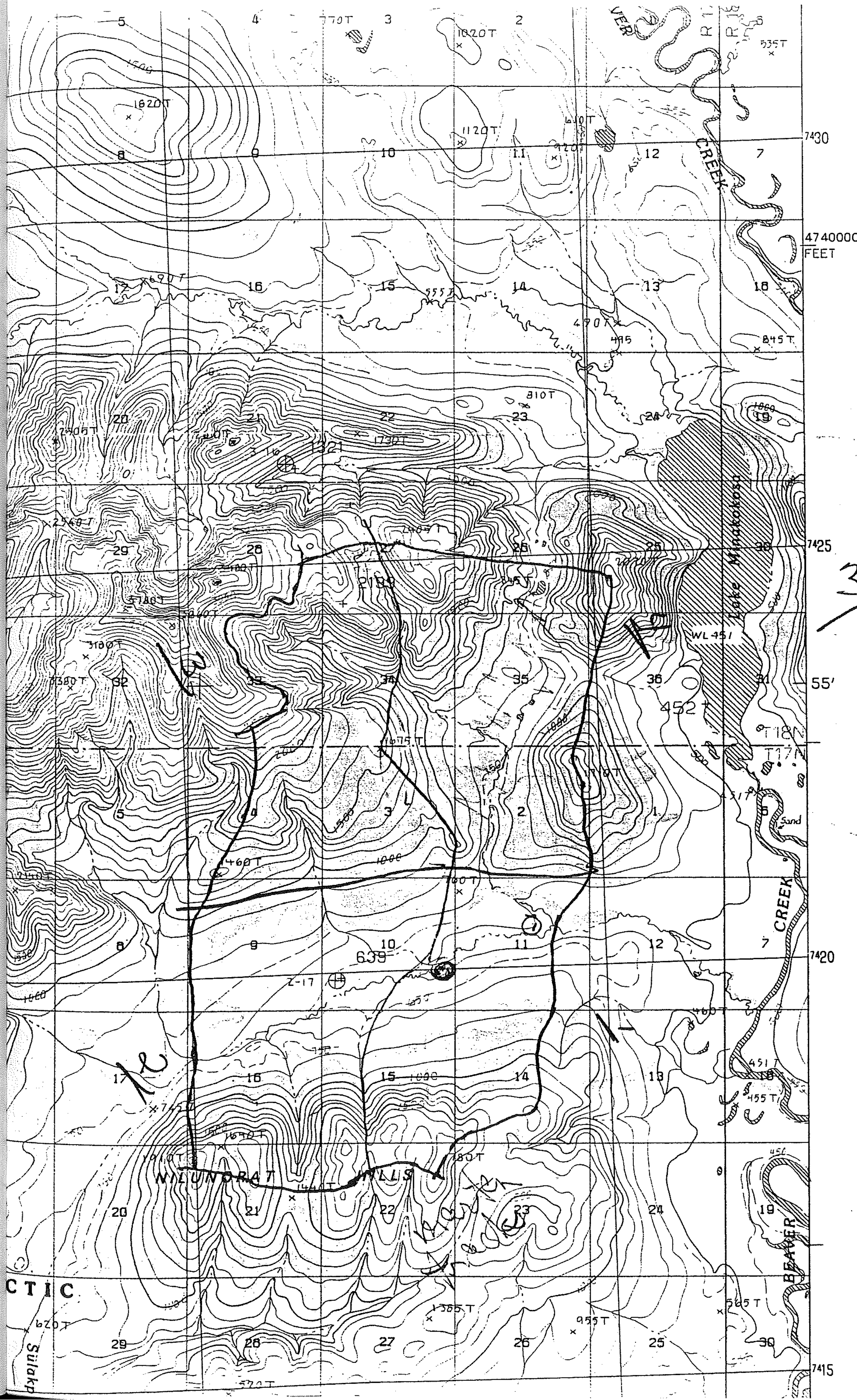
100
96
CREEK
BEAVER
CREEK
BEAVER
CREEK
T 19 N
T 18 N
R 16 E
R 17 E
R 18 E
MOUNTAINS
ANGAY
Lake Minakokosa
BEAVER 1981
WL 451


BEAVER CREEK
REED
T 19 N
T 18 N
R 17 E
R 18 E
99
100
96
98
1000
1500
2000
2500
550
650
750

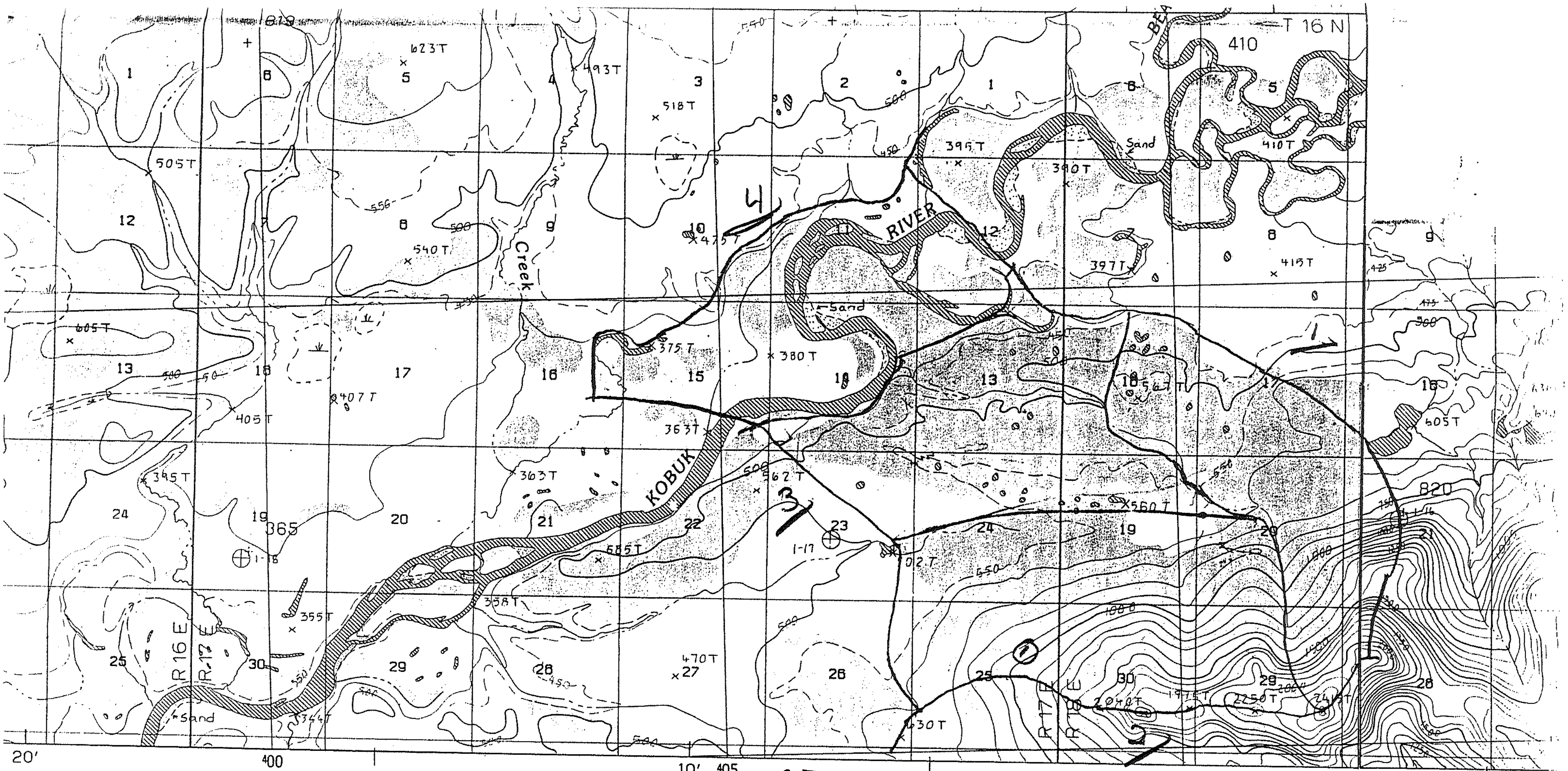


KOBUK
64
River

Kokumpat
Creek
Kokumpat
Creek
KOBUK
CABIN
T 16 N
T 15 N
R 13 E
R 14 E
R 14 E
R 15 E


CREEK
Lake Minakokosa
WL 451
452
T18N
T17N
55'
4740000
FEET
NILUNORAT HILLS
BEAVER
CREEK
Sand
CTIC
1620T
1120T
1020T
2189
1321
639
Z-17
1675T
1460T
1385T
955T
565T
845T
810T
1730T
2405T
3180T
3380T
451T
455T
460T

39



SCALE 1:63 360

CONTOUR INTERVAL 100 FEET
SUPPLEMENTAL CONTOUR INTERVAL 50 FEET

To convert meters to feet multiply by 3.2808
To convert feet to meters multiply by .3048

INTERIOR–GEOLOGICAL SURVEY, RESTON, VIRGINIA–

...DUCED BY THE U...
...TROL BY ...
...PILED FR...

QUADRANGLE LOCATION

ROAD LEGEND

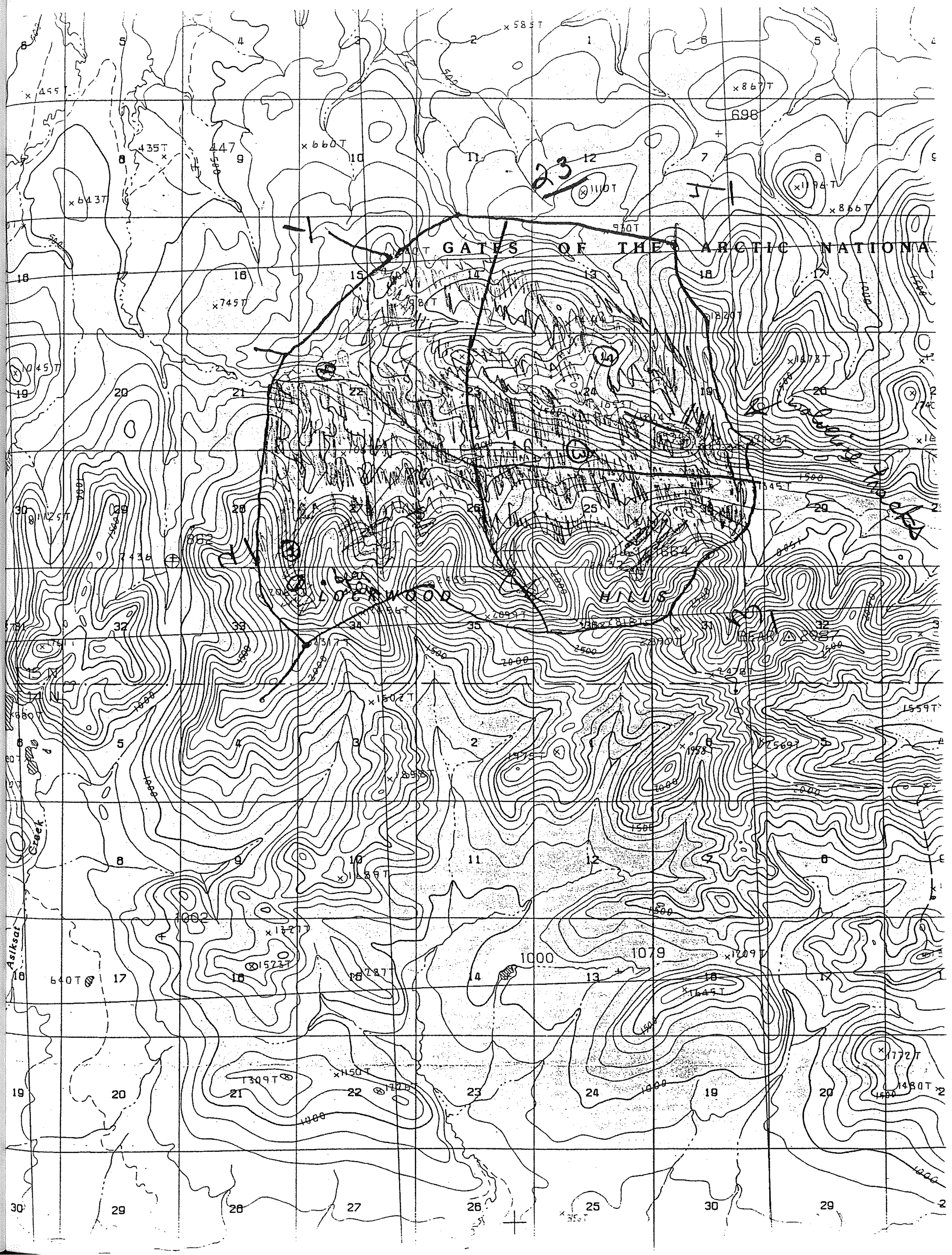
No roads or trails in this area

1	2	3	1 Survey Pass (A-6) 2 Survey Pass (A-5) 3 Survey Pass (A-4) 4 Hughes (D-6) 5 Hughes (D-4) 6 Hughes (C-6) 7 Hughes (C-5) 8 Hughes (C-4)
4		5	
6	7	8	

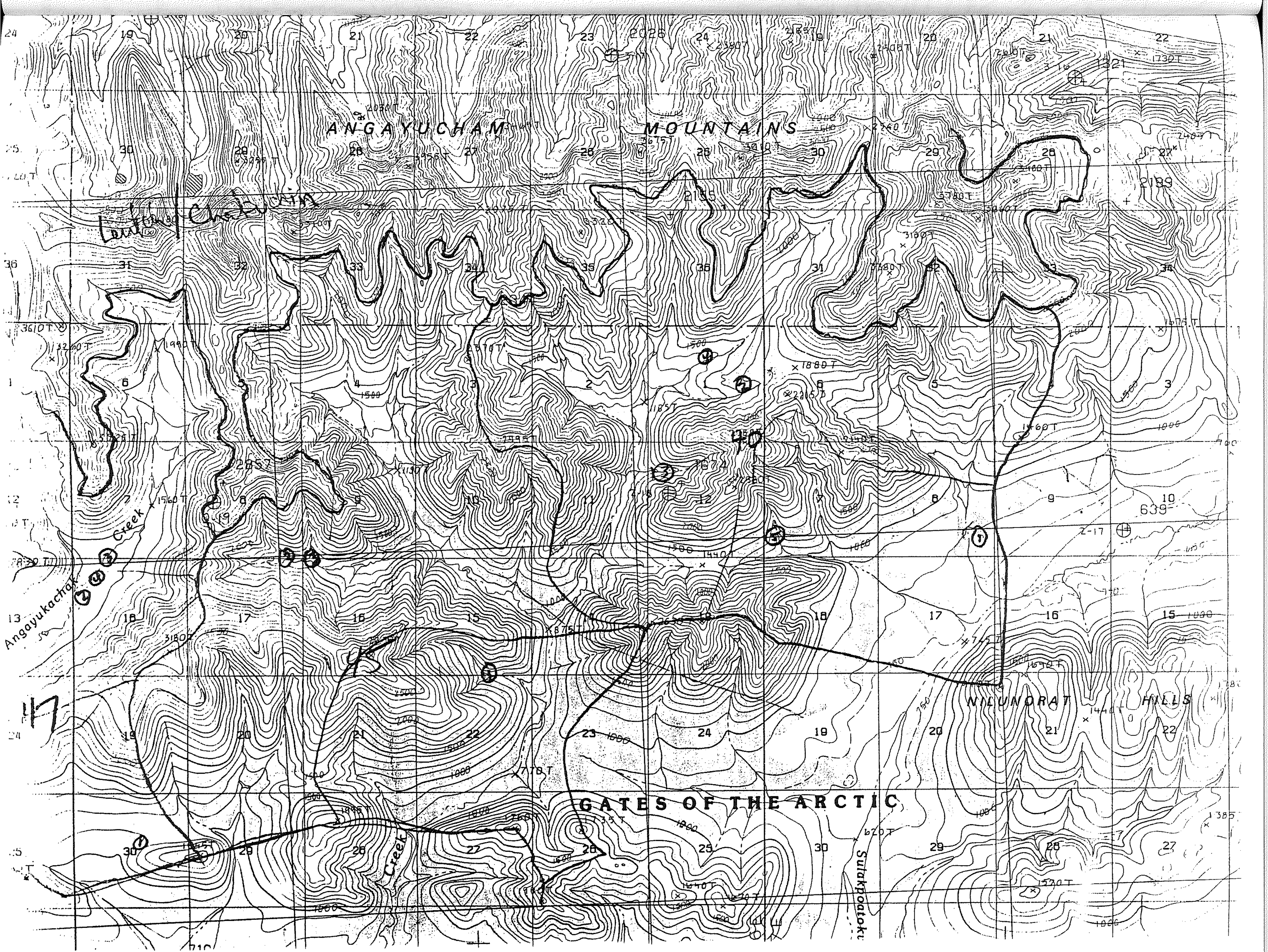
ADJOINING QUADRANGLE NAMES

FOR SALE BY U.S. GEOLOGICAL SURVEY, FAIRBANKS, ALASKA 99701
DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

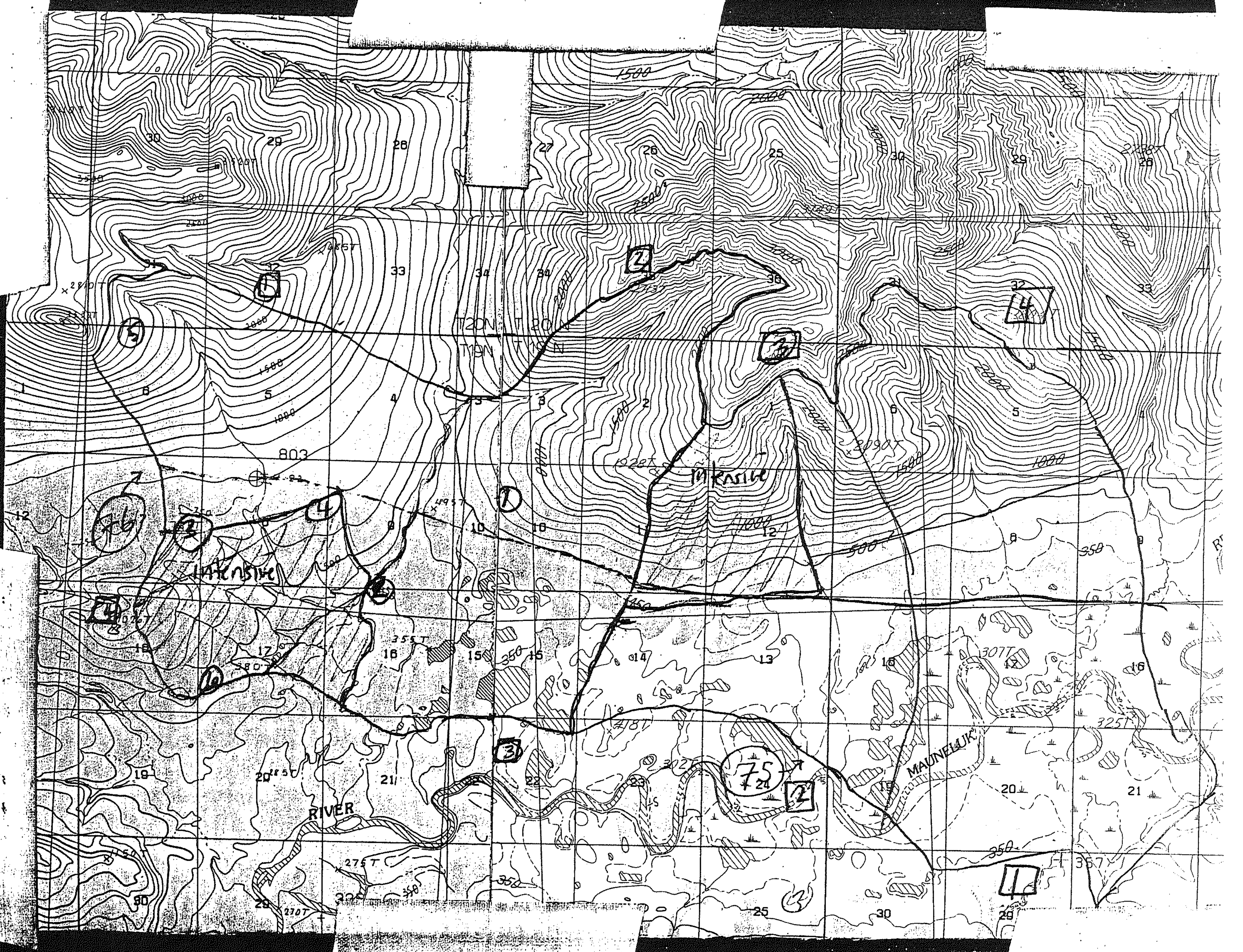
HUGHES (D–5), ALASKA
PROVISIONAL EDITION 1986


GATES OF THE ARCTIC NATIONA
LOCKWOOD HILLS
Asiksat
Creek
23
1000
1079
1002
698
447
862
1664


ANGAYUCHAM
MOUNTA
MOUNTAINS
ANGAYUCHAM
Frine Mountain
NARVAK
LAKE
Angayukachak Creek
Creek
Creek
GATES OF TH
T18N
T17N

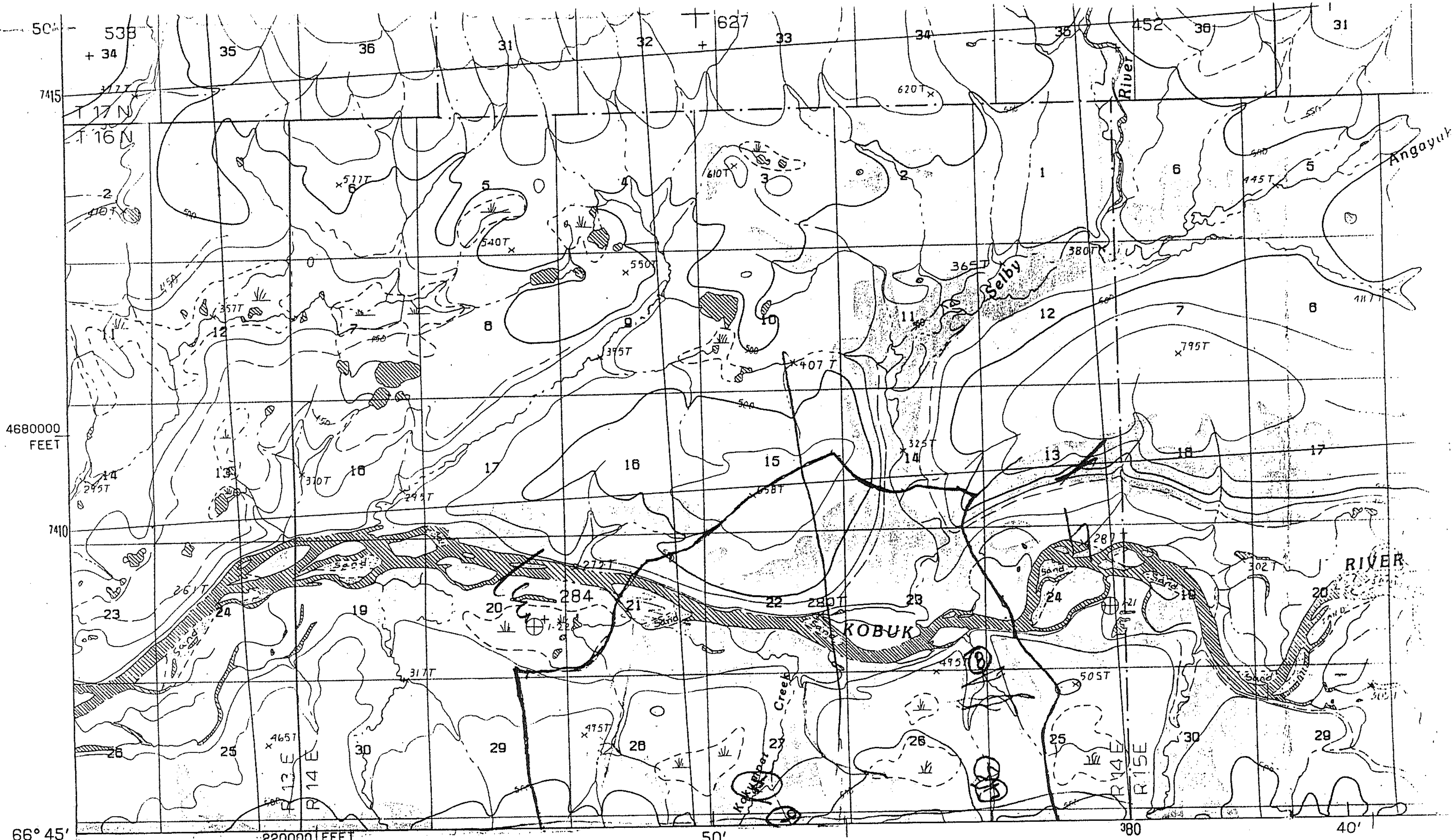


ANGAYUCHAM MOUNTAINS
GATES OF THE ARCTIC
NILUNORAT HILLS
Angayukachak Creek
Creek
Sulakpoatoki
117



T20N T20N
T19N T19N
RIVER
MAUNELUK
Intensive
Intensive
75
76
803


86
Intensive
12 min
Mostly white
1
2
3
4
Aoaraaq Lake
WL 337
361
352T
377T
397T
547T
584T
751T
542T
500
1000
1500
2000
450



PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY
CONTROL BY .... USGS, NOS/NOAA
COMPILED FROM AERIAL PHOTOGRAPHS TAKEN .... 1970 AND 1971
MAP NOT FIELD CHECKED. MAP EDITED 1986
PROJECTION .... UNIVERSAL TRANSVERSE MERCATOR
GRID: 5000-METER UNIVERSAL TRANSVERSE MERCATOR .... ZONE 5
20,000-FOOT STATE GRID TICKS .... ALASKA, ZONE 5
UTM GRID DECLINATION .... 2°32′ WEST
1986 MAGNETIC NORTH DECLINATION .... 23°30′ EAST
VERTICAL DATUM .... NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM .... 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines 62 meters north and 124 meters east

Land lines represent unsurveyed and unmarked locations predetermined by the Bureau of Land Management, Folios K-2 and K-8, Kateel River Meridian

There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map

Federal Reservation boundaries established by the Alaska National

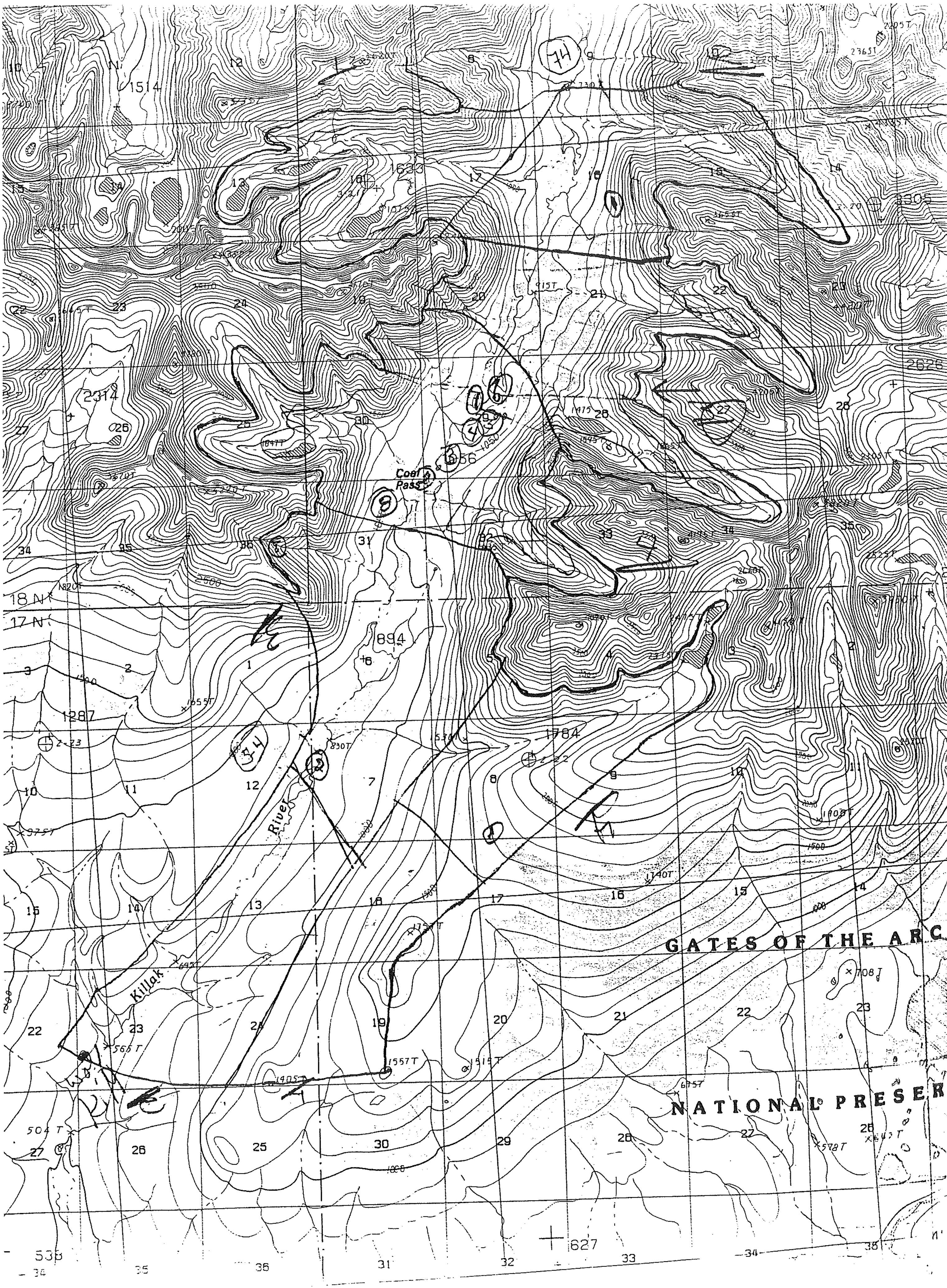
SCALE 1:63 360

CONTOUR INTERVAL 100 FEET
SUPPLEMENTAL CONTOUR INTERVAL 50 FEET

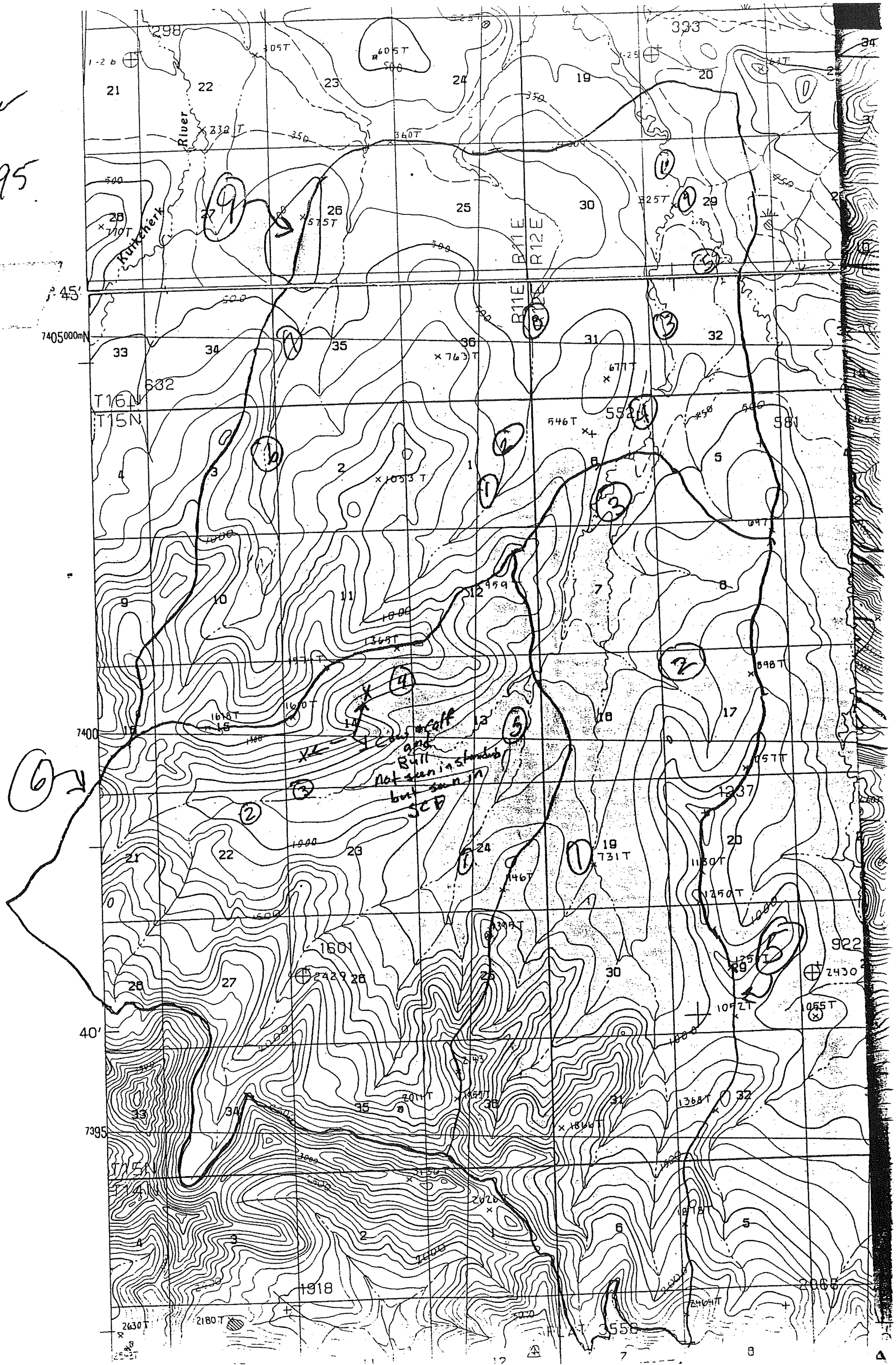
PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of photography

3

To convert meters to feet multiply by 3.2808
To convert feet to meters multiply by .3048


GATES OF THE ARC
NATIONAL PRESER
Coal Pass
Killak
River
1514
1633
2314
1287
894
1784
2626
3305
18 N
17 N
627
538

Machida / Selinger
11/7/95



11/8/95
Machida/Selinger